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DEPARTMENT OF ENERGY'S FACILITIES FOR DEFENSE MATERIALS PRODUCTION

HEARINGS

BEFORE THE

COMMITTEE ON ENERGY AND NATURAL RESOURCES UNITED STATES SENATE

ONE HUNDREDTH CONGRESS

FIRST SESSION

ON THE

STATUS OF THE DEPARTMENT OF ENERGY'S EFFECTS TO ADDRESS ISSUES CONCERNING THE DEFENSE MATERIALS PRODUCTION REACTORS LOCATED IN THE UNITED STATES

OCTOBER 27 AND 29, 1987

PART 2

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DEPARTMENT OF ENERGY'S FACILITIES FOR DEFENSE MATERIALS PRODUCTION

TUESDAY, OCTOBER 27, 1987

U.S. SENATE,
COMMITTEE ON ENERGY AND NATURAL RESOURCES,
Washington, DC.

The committee met, pursuant to notice, at 10:12 a.m. in room S–407, The Capitol, Hon. J. Bennett Johnston, chairman, presiding.

OPENING STATEMENT OF HON. J. BENNETT JOHNSTON, U.S. SENATOR FROM LOUISIANA

The CHAIRMAN. Good morning. The purpose of today's hearing is to receive testimony on our nuclear materials needs and to assess our capability to meet those needs with existing facilities or with new production facilities.

This morning, we will hear from the Department of Defense and the Department of Energy on their projections of short and long term requirements for nuclear materials. We will also hear from these witnesses on the status and condition of existing facilities and on the need for new facilities.

This hearing will continue on Thursday afternoon, at which time we will hear from the National Academy of Sciences on their just completed study of the safety of existing facilities.

All of DOE's production facilities date back to the 1950's and early 1960's. Many of the original facilities have been shut down permanently. The weapons complex now depends on the N-Reactor at the Hanford Reservation and three reactors at the Savannah River plant.

Questions have been raised about the safety of all four of these reactors and these safety concerns have produced severe credibility problems for the Department and its contractors.

The N-Reactor at Hanford is currently shut down, while millions of dollars of hardware modifications are completed. The three reactors at Savannah River are operating at reduced power because of concerns over the potential inadequacy of emergency cooling systems.

These questions about safety led the Department to ask the National Academy of Sciences to conduct an independent analysis of the condition of these existing facilities and the adequacy of reactor safety management.

On Thursday, we will hear from the Academy on the findings of this study.

Recent news reports of the findings of this study indicate that there may indeed be serious safety problems at these facilities. If that is the case, we must do something to solve this problem.

If newer, safer facilities are needed, we must authorize them and get on with building them.

So, let's get on with today's hearing. The important questions that we need to answer this morning are:

What are the actual materials needs?

How serious are the safety concerns raised about our existing facilities?

How long can we depend on these facilities? and

How soon will new production capability be required?

Before I call on our first witnesses, I would like to ask Senator McClure for his comments.

STATEMENT OF HON. JAMES A. McCLURE, U.S. SENATOR FROM IDAHO

Senator McCLURE. Thank you very much, Mr. Chairman.

Let me first express my very sincere appreciation to the Chairman for his perseverence in scheduling this hearing.

This hearing is a culmination of a lot of efforts over a long period of time, and I congratulate you and commend you for having brought us to this point.

I have had a personal interest in the health of our nuclear materials production complex for a number of years, now. In the early 1970s, I supported the planning for a replacement production reactor, the RPR, successfully fought against the Carter Administration's attempt to terminate the planning of what has now become the new production reactor, the NPR, only to see it dropped in the early years of the Reagan Administration for budgetary reasons.

My concerns have become more intensified of late as a result of a number of very disconcerting events.

First, the Chernobyl accident a year ago last April shocked this Nation into a total reevaluation of the safety of our entire nuclear industry. Fortunately, because of significant design differences between United States and Soviet technologies, we survived that reevaluation relatively unscathed, although the smoldering fears may become a raging inferno with the slightest breeze.

But there is one potential casualty from that evaluation whose prognosis is still unclear, and that is the Department of Energy's N-Reactor in Hanford, Washington.

Based on recommendations made by internal and outside experts that subsequently evaluated the safety of that reactor, the N-Reactor remains today in a shut-down condition, until significant modifications can be made.

Conditions at our materials production facilities at Savannah River, though not directly tied to the Chernobyl incident, are, nevertheless not much better. The crack in C Reactor vessel, which was discovered in 1985 and portrayed as "fixable," has since been found to be irreparable, and the reactor is permanently shut down.

The remaining three Savannah River plants have been reduced from 100-percent power to 50-percent power, due to inadequacies

recently discovered with respect to emergency core cooling capabilities.

So, what 2 years ago was a complex of five operable production reactors has been reduced as a result of these bizarre circumstances to just one and a half reactor's worth of production capacity.

Add to that the fact that in 1985 the Department cancelled its ongoing activities for construction of a new production ractor at the Idaho National Engineering Lab, I would add here parenthetically, that what we have here is a truly preposterous situation.

It is unfortunate that the National Academy of Sciences could not be here today to shed some light on this as a result of their thorough review of the Department's production reactors.

We already have a stacked deck, and NAS appears to hold the trump card. But, unfortunately, we won't get a chance to hear form them until this coming Thursday, after their final report is released.

I am hopeful that they will have something positive to add to this. But, from what I have heard so far about their study, I am afraid it may only add insult to injury.

I am not one to take a defeatist attitude about all of this. I think there are some very positive steps that could be taken to see us through this dilemma. We must begin taking those steps now, however, if we want to avoid a situation where we might find ourselves with no production capabilities whatsoever for an indefinite length of time.

That situation, in my mind, is totally unacceptable, and is at least as dangerous to this county as any reactor safety issue raised so far.

I am anxious to hear what steps the Department of Energy has taken to date, and what actions it plans to take in the near future to assure the public that its production reactors will operate within acceptable safety limits, while, at the same time, assuring the Defense Department that it will have an adequate supply of nuclear materials for the foreseeable future.

I am also anxious to hear about DOE's plans with respect to the acquisition of new production reactor capacity. Had we stayed the course begun in the 1970s which culminated in 1983, we would already be building that needed capacity, or at least a portion of it. But I will not belabor that point.

It does illustrate, however, how easily one can back away from a commitment when faced with budgetary constraints.

Well, the budgetary constraints have not gotten any better, but the need for new production reactor capacity has gotten far greater. I just hope that the Department can make the right decision and carry them through this time.

I am here to offer you my support in seeing that these decisions become reality. I only ask that the Department use all its resources in an open-minded, creative, and far-sighted manner, so that its decision will stand the test of time, and so that we never again find ourselves in the kind of vulnerable position that we are now faced with today.

Thank you very much, Mr. Chairman.

The CHAIRMAN. Thank you, Senator McClure.

We must now formally close the meeting.

I think everyone here has been cleared. If they have not, they should leave at this time.

[Whereupon, at 10:19 a.m., the committee recessed, to reconvene in Executive Session upon the call of the Chair.]

DEPARTMENT OF ENERGY'S FACILITIES FOR DEFENSE MATERIALS PRODUCTION

THURSDAY, OCTOBER 29, 1987

U.S. SENATE,
COMMITTEE ON ENERGY AND NATURAL RESOURCES,
Washington, DC.

The committee met, pursuant to notice, at 12:18 p.m., in room SD-366, Dirksen Senate Office Building, Hon. Timothy E. Wirth presiding.

OPENING STATEMENT OF HON. TIMOTHY E. WIRTH, U.S. SENATOR FROM COLORADO

Senator WIRTH. The committee would come to order. Gentlemen, we thank you very much for your forbearance. Senator McClure is at the White House for the announcement of the Supreme Court nominee by the President, and we were waiting in hopes that he might be back. He'll be back shortly. But we thought for the purposes of your convenience and time, we might proceed. So, on the record I want to offer my apologies to Senator McClure, and we will, of course, leave the record open for his opening statement.

I also bring apologies from Senator Johnston, Chaiman of the full committee, who as you know is embroiled in the easy task of the budget negotiations. So, we have Senator McClure on one easy task and Senator Johnston on another, leaving us with the easy part of the Federal nuclear facilities problem.

This afternoon we will continue the committee's hearings on the Department of Energy's defense production facilities. The purpose of this two day hearing has been to get a complete picture of our nuclear materials needs and our ability to meet those needs with existing facilities or new production facilities. Today, we will hear from the National Academy of Sciences on its just-released study of the safety of our existing facilities.

Last Tuesday, we heard from the Department of Defense and the Department of Energy on their projections of short- and long-term requirements for nuclear materials. We heard from these witnesses that there is a serious question about how long we can depend on our existing facilities to meet those requirements. We heard that we need to get on with efforts to build new production capacity and to examine very carefully the whole rest of the network that supports the production facilities.

All of DOE's defense production facilities date back to the 1950's and early 1960's. Many of the original facilities have been shut down permanently. The weapons complex now depends on the N

reactor at the Hanford Reservation and three reactors at Savannah River. But all four of these facilities are old, and all four of these facilities are either shut down or operating at reduced power because of unresolved safety concerns. Meanwhile we do not have new reactor capacity available.

Today I'm afraid that we will not hear much good news from the National Academy either. I'm afraid that the results of the Academy's review are dismal. They are dismal because they confirm that safety improvements are needed at our existing facilities and have been needed for some time. They are dismal because they confirm that the Department of Energy's oversight of these facilities has been singularly lacking.

To the Department of Energy's credit, this independent review by the Academy was initiated at their request. In calling their record dismal, I should also commend Secretary Herrington for starting, although belately, an effort on behalf of the Department of Energy to undertake a more careful examination. I hope this is an indication that the Department realizes that it has a problem and that the Department will seize upon this opportunity to fix the problem.

We are anxious to hear today from the Academy on the findings of its long-awaited report on the safety of our existing production facilities.

Before going to our witness, let me ask Senator Evans if he has opening comments or an opening statement that he might like to make.

[The prepared statements of Senator Johnston and Senator McClure follow:]

STATEMENT OF SENATOR J. BENNETT JOHNSTON

COMMITTEE ON ENERGY AND NATURAL RESOURCES
HEARING ON THE DEPARTMENT OF ENERGY'S DEFENSE PRODUCTION FACILITIES

October 29, 1987

This afternoon, we are continuing our hearing on the status and condition of our existing defense production facilities and the need for new facilities. Today we will hear from the National Academy of Sciences on their just-completed study of the safety of our existing facilities.

Earlier this week we heard from the Department of Defense and the Department of Energy on their projections of short- and long-term requirements for nuclear materials. We heard from these witnesses that there are valid reasons to be concerned about the condition of existing facilities and that we need to get on with efforts to build new production capacity.

All of DOE's defense production facilities date back to the 1950s and early 1960s. Many of the original facilities have been shut down permanently. The weapons complex now depends on the N-Reactor at the Hanford Reservation and 3 reactors at the Savannah River Plant. The N-Reactor and the L-Reactor at Savannah River both produce plutonium, while the P- and the K-Reactors at Savannah River produce tritium. Both of these materials are

necessary if we are to continue to meet our needs outlined in the President's Nuclear Weapons Stockpile Memorandum. There is no escaping this fact.

There is serious question about how long we can depend on our existing facilities. We have allowed ourselves to get into the situation where our reactors are shut down or operating at reduced power because of unresolved safety concerns. Many of these problems stem from the inevitable fact that the facilities built in the 1950s and 60s are wearing out. It has been clear that we would have to retire old plants and build new capacity. The Administration has never requested funds for this purpose.

We have a serious situation that must be dealt with. Unfortunately, the vulnerabilities of our existing facilities did not get significant attention from the Administration until after the April 1986 Chernobyl accident forced them to take notice.

Following the Chernobyl accident, the public demanded that greater attention be paid to the health and safety issues related to our defense production facilities. Largely as a result of Chernobyl, the N-Reactor at Hanford is shut down while millions of dollars of long-overdue hardware modifications are completed. The 3 reactors at Savannah River are operating at reduced power because of concerns over the potential inadequacy of emergency

cooling systems. Questions about safety led the Department to ask the National Academy of Sciences to conduct an independent analysis of the condition of these existing facilities and the adequacy of reactor safety management.

The results of the Academy's study are not encouraging. The results confirm our concerns about the condition of our existing facilities. They confirm the need to get on with building new facilities. They confirm that the Administration has focused all its attention and resources on new, expensive weapons delivery systems while paying only scant attention to the condition of our aging production facilities.

A new production reactor is estimated to cost between $3 and $5 billion. But it may be that we need to overhaul our entire weapons production complex. The cost of that endeavor is likely to be closer to hundreds of billions of dollars.

So the time has come to swallow hard and deal with the bad news. We need to honestly assess the condition of our existing facilities and get on with addressing the problems. If our existing facilities are as vulnerable as it appears they may be, we need to get on with some hard choices on where to place our resources. We cannot keep spending billions of dollars on one

end of the process while ignoring the vulnerabilities on the other end of the process.

I am anxious to hear today from the National Academy of Sciences on the findings of their long-awaited report on the safety of our existing production facilities. Our witness today is Mr. Richard Meserve, Chairman of the NAS Committee to Assess Safety and Technical Issues at DOE Reactors.

OPENING STATEMENT - SENATOR JAMES A. McCLURE
OCTOBER 29, 1987

GOOD AFTERNOON. WE ARE FORTUNATE TO HAVE BEEN ABLE TO SCHEDULE THE NATIONAL ACADEMY OF SCIENCES TO APPEAR BEFORE US TODAY, CONSIDERING THE DEMANDS THAT ARE BEING PLACED ON THEM TODAY, ON THE OCCASION OF THE FORMAL RELEASE OF THEIR REPORT ON THE DEPARTMENT OF ENERGY'S DEFENSE PRODUCTION REACTOR SAFETY.

WE ARE ANXIOUS TO HEAR FIRST-HAND THE RESULTS OF THE ACADEMY'S LONG-AWAITED STUDY, WHICH WAS INITIATED BY DOE FOLLOWING A NUMBER OF EVENTS SURROUNDING OUR MATERIALS PRODUCTION COMPLEX: FIRST, THE SHUTDOWN OF THE C-REACTOR AT SAVANNAH RIVER, DUE TO IRREPARABLE CRACKS IN THE REACTOR VESSEL; THEN, THE SHUTDOWN OF THE N-REACTOR IN HANFORD, WASHINGTON, FOR A NUMBER OF POST-CHERNOBYL, SAFETY-RELATED MODIFICATIONS; AND FINALLY, THE REDUCTION IN OPERATING LEVELS OF THE REMAINING THREE REACTORS AT SAVANNAH RIVER, DUE TO DESIGN DEFICIENCIES RECENTLY IDENTIFIED. SO, WHAT TWO YEARS AGO WAS A COMPLEX OF FIVE OPERABLE PRODUCTION REACTORS IS NOW REDUCED TO THE EQUIVALENT OF JUST ONE AND ONE HALF REACTORS' WORTH OF PRODUCTION CAPACITY.

I FIND THIS SITUATION TO BE MOST DISCONCERTING, BECAUSE IT COULD HAVE BEEN AVOIDED ALTOGETHER, HAD WE TAKEN THE STEPS WE SET OUT TO TAKE BACK IN THE 1970'S, TO BEGIN BUILDING NEW PRODUCTION REACTORS TO REPLACE THESE OLD WORKHORSES.

BUT I CAN'T UNDO THE PAST. EVEN IF WE WERE TO BEGIN TODAY TO BUILD NEW PRODUCTION CAPACITY, WE WOULD NOT BE OUT OF THIS

PREDICAMENT FOR A DECADE SIMPLY BECAUSE, AS WE ALL KNOW, REACTOR CONSTRUCTION TAKES A LONG TIME.

So the best we can do for now is to expedite consideration of the recommendations of the Academy report, and see where we need to go from there.

From my review of the report, I find it to be straightforward and comprehensive. However, it is less than complimentary of the Department's production reactor complex. Some might even be able to twist the contents enough to suggest that the report is condemning of the complex. I will take exception to those critics, because I feel they are taking a totally irresponsible position.

The public has a right to know the facts concerning the safety condition of our materials production complex. But even more importantly, we have an obligation to use and interpret those facts responsibly.

I interpret those facts in the following manner: We have an aging set of production reactors that have operated for some 30 years now without any adverse consequences to public health and safety. Yet, because of a number of advancements made in the technology and in the techniques available to quantify and verify the safety of reactors over the last 30 years, we find ourselves in a situation where we don't know the precise safety margins of

THESE OLDER MACHINES. THEREFORE, WE CAN'T DEMONSTRATE WITH 100% CERTAINTY THAT THEIR OPERATING LIMITS ARE ADEQUATE, OR THAT CERTAIN MODIFICATIONS OUGHT NOT TO BE DONE, IN ORDER TO BRING THESE MACHINES WITHIN MORE ACCEPTABLE AND MODERN SAFETY MARGINS. AND UNTIL WE RUN THROUGH THESE CALCULATIONS TO QUANTIFY JUST EXACTLY WHERE WE STAND, WE CAN'T TRANSLATE THE CONDITION OF THESE REACTORS INTO TODAY'S SOPHISTICATED SAFETY LANGUAGE. SURE, DOE COULD AND SHOULD HAVE BEGUN THOSE CALCULATIONS MANY YEARS AGO. THEY COULD AND SHOULD HAVE BEEN MORE AGGRESSIVE IN UPDATING THESE MACHINES TO REFLECT TECHNOLOGY ADVANCEMENTS AND THE "LESSONS LEARNED" OVER THE YEARS.

NOTHING SPEAKS BETTER THAN 20/20 HINDSIGHT ON WHAT DOE COULD OR SHOULD HAVE DONE WITH RESPECT TO THESE PRODUCTION REACTORS, OR WITH RESPECT TO THE PLANNING AND CONSTRUCTION OF REPLACEMENT PRODUCTION CAPACITY.

IT IS IMPORTANT TO KNOW HOW WE ARRIVED AT THIS POINT, BUT NOT NEARLY AS IMPORTANT AS WHERE WE PROCEED FROM HERE. LET ME SHARE WITH YOU MY THOUGHTS ON THIS:

- FIRST, WE WILL CONTINUE TO RUN THE SAVANNAH RIVER REACTORS, BECAUSE WE HAVE TO HAVE THEIR OUTPUT. WE HAVE NO ALTERNATIVE FOR PRODUCTION OF TRITIUM AND PLUTONIUM. NO AMOUNT OF ARMS CONTROL PROGRESS WILL ALLEVIATE THE NEED FOR THESE MATERIALS, AS WE WERE MADE ACUTELY AWARE IN TUESDAY'S HEARINGS.

- WE WILL MAKE EVERY EFFORT TO ASSURE THAT THE PRESENT PRODUCTION REACTORS OPERATE WITHIN ACCEPTABLE MARGINS OF SAFETY. CURRENTLY, THAT REQUIRES THAT WE LIMIT THE OUTPUT OF THE SAVANNAH RIVER REACTORS TO 50% POWER LEVEL, WHICH THE NAS HAS NOT DETERMINED TO BE UNSAFE OR UNREASONABLE. HAD THEY FOUND MORE SERIOUS OR IMMEDIATE PROBLEMS, THEY WOULD HAVE RAISED THEM WITH DOE PROMPTLY, AS DOE HAD REQUESTED THEM TO DO. NO SUCH PROBLEMS WERE FOUND.

- SOME PEOPLE WILL SELECTIVELY QUOTE FROM THE ACADEMY REPORT IN AN ATTEMPT TO SHUT DOWN THESE REACTORS ALTOGETHER, DESPITE WHAT I HAVE JUST SAID. AND WHAT PROBABLY WON'T MAKE THE HEADLINES ARE THE POSITIVE STATEMENTS FOUND IN THE REPORT, INCLUDING THE FACT THAT THESE REACTORS HAVE MANY DESIRABLE SAFETY FEATURES THAT, BY THEIR VERY NATURE, MINIMIZE THE LIKELIHOOD AND EXTENT OF ACCIDENTS, PARTICULARLY AT 50 PERCENT POWER: LOW TEMPERATURE AND PRESSURE, LARGE HEAT CAPACITY, NEGATIVE POWER COEFFICIENTS, AND A 25-YEAR, ACCIDENT-FREE OPERATING HISTORY.

- WE WILL SEE TO IT THAT THE RECOMMENDATIONS OF THE NAS STUDY ARE IMPLEMENTED IN AN EXPEDITIOUS FASHION. WHATEVER CALCULATIONS, SEVERE ACCIDENT SAFETY ANALYSES, PROBABILISTIC RISK ASSESSMENTS, MODIFICATIONS, INSPECTIONS, AND INSTITUTIONAL CORRECTIONS ARE NEEDED, WE MUST GET ON WITH THE TASKS IN ORDER TO ASSURE THE PUBLIC THAT THESE PRODUCTION REACTORS WILL OPERATE SAFELY AND TO ASSURE THE

DEFENSE DEPARTMENT AN ADEQUATE SUPPLY OF NUCLEAR MATERIALS FOR THE FORESEEABLE FUTURE.

o WE MUST BEGIN THE PLANNING PROCESS FOR BRINGING REPLACEMENT PRODUCTION REACTOR CAPACITY ON-LINE AS SOON AS POSSIBLE -- HOPEFULLY BEFORE THE CURRENT REACTORS REACH THE END OF THEIR DESIGN LIFE. IN MAKING ITS DECISIONS ON THE NEXT GENERATION OF PRODUCTION REACTORS, I WOULD HOPE THAT THE DEPARTMENT OF ENERGY WILL CHOOSE WISELY, IN AN OPEN-MINDED, CREATIVE, AND FARSIGHTED MANNER. I HOPE THE DEPARTMENT WOULD NOT PLACE ALL ITS EGGS IN ONE BASKET -- THAT IT WILL RECOGNIZE THE CRITICAL ROLE THAT REDUNDANCY OF SITES AND DESIGNS WILL PLAY IN ENABLING US TO TRANSCEND THE CURRENT, VERY FRAGILE POSITION THAT WE ARE NOW FACED WITH.

I OFFER MY SUPPORT IN SEEING THAT THE DEPARTMENT OF ENERGY HAS AVAILABLE TO IT ALL THE RESOURCES NECESSARY TO ADDRESS AND RESOLVE THE CURRENT ISSUES RAISED BY THE ACADEMY. I ALSO OFFER MY ASSISTANCE IN ACHIEVING EARLY AUTHORIZATION AND CONSTRUCTION OF REPLACEMENT PRODUCTION CAPACITY THAT CAN TAKE OVER THE JOB OF SUPPLYING THIS NATION'S NUCLEAR MATERIALS REQUIREMENTS IN AN ENVIRONMENTALLY SOUND MANNER, IN THE NOT-TOO-DISTANT FUTURE.

STATEMENT OF HON. DANIEL J. EVANS, U.S. SENATOR FROM WASHINGTON

Senator EVANS. Thank you, Mr. Chairman.

First let me join with the Chairman and the other members of the committee on commending the National Academy of Sciences for a first class job, one that continues to keep the consistently high standards of the Academy and will be an importment document in the work that we must do.

I think it should be emphasized, however, as I suspect our witnesses will tell us today, that the report doesn't examine all of the safety and environmental features of the production reactors. The committee itself said that it does not address such issues as safeguards and security, fuel handling and transportation, occupational safety, fire protection, quality assurance or waste management. But it does give us some most significant recommendations.

And I guess I would not use the same term that the Chairman used in terms of dismal. I think that it points out some difficult problems. It also points out in my reading the good things that contractors and DOE are doing. I think that we must take this report and examine its recommendations, together with the earlier report by the contractor at the N reactor, Westinghouse in August, the Roddis Panel, the other DOE internal reports, and collectively we have then a pretty good picture of what must be done on one side of the equation in making a determination on continued operation of the Savannah River reactors or a restart at the N reactor.

I think it is important for all of those observing from the outside in trying to report as carefully and completely as possible to the citizens of the country, and particularly citizens of these two particular areas of the country, exactly where we are. I think at times there have been stories that have, for whatever reasons, become scare stories which were inappropriate. The Chernobyl accident immediately brought the kind of comparisons that some made with the N reactor at Hanford. And I think that it is important for people to carefully read recommendations and the descriptions of the National Academy of Sciences in pointing out that while there are similarities, there are some very significant differences in the operation of the two reactors. And people ought to know that so that at least they have a clear and consistent picture of where we are rather than a distorted one.

The National Academy of Sciences, of course, is not a regulator. They in their panel have given us some conceptual approaches towards safety and some very fine, specific recommendations. And that's the appropriate function for the Academy to play.

The tough decisions are ones that we are going to have to make—the administration and by the Congress. We are the policymakers who are ultimately going to have to take the information we get and then make the decisions based on an appropriate balance between need on the one hand and risk on the other. And that's the other half of the equation.

Now, we will hear a report today that is thorough, competent and complete in terms of safety elements, both their deficiencies, those which can be corrected, and those which by the very design of those old reactors probably cannot be corrected. And we will

have to measure then where we are against the other half of the equation. And we did hear in the closed hearing on Tuesday the other focus. And that is the need for defense materials. And that's going to be a tough decision for us to make. And we are going to have to make it with all of the information we can garner. To what degree are these reactors safe to operate keeping in mind the needs for national security for their production.

Mr. Chairman, I think that's the key decision that we are going to have to ultimately make. And I hope that at the end of all of this we will have gotten information clearly enough across to people and to our colleagues so that we will develop a broad consensus, a broad consensus of what we do in the longer term.

That's probably best gained through an authorizing bill ultimately, an authorizing bill which talks perhaps about independent oversight, about the authorization of new production reactors if it is felt those are necessary, about a permanent funding mechanism for environmental restoration and permanent disposal of those reactors' waste streams. We have had an extraordinary amount of information and activity about nuclear waste disposal of the civilian reactors, not realizing that we have produced and are still producing a very substantial high level waste from our military production reactors and have not done, in my view at least, anywhere near enough to adequately handle their waste streams.

And finally, we have got to come to a point where we have more accountability to the public, a greater dissemination of clear information and hopefully in doing so, we will change the tenor and the tone of the debate in the country to one which has a much larger share of good information and a much smaller share of emotion in the debate than has been characterized by the past.

Senator WIRTH. Thank you, Senator Evans.

Senator Hecht.

Senator HECHT. Thank you. No statement.

Senator WIRTH. Mr. Meserve, we are delighted to have you here. Our lead witness today is Mr. Richard Meserve, Chairman of the National Academy of Sciences Committee to Assess Safety and Technical Issues at DOE Reactors. We appreciate your being here, Mr. Meserve. Perhaps for the purposes of the record you might identify the individuals who are accompanying you, and then proceed in whatever way you believe would be most appropriate and helpful.

STATEMENT OF RICHARD MESERVE, CHAIRMAN, COMMITTEE TO ASSESS SAFETY AND TECHNICAL ISSUES AT DEPARTMENT OF ENERGY REACTORS, NATIONAL RESEARCH COUNCIL, ACCOMPANIED BY DR. BILL KASTENBERG, DEPARTMENT OF NUCLEAR ENGINEERING, UCLA, MEMBER, COMMITTEE TO ASSESS SAFETY AND TECHNICAL ISSUES AT DEPARTMENT OF ENERGY REACTORS, NATIONAL RESEARCH COUNCIL; DR. DANA A. POWERS, SANDIA NATIONAL LABORATORY, MEMBER, COMMITTEE TO ASSESS SAFETY AND TECHNICAL ISSUES AT DEPARTMENT OF ENERGY REACTORS; STEVEN M. BLUSH, STUDY DIRECTOR, COMMITTEE TO ASSESS SAFETY AND TECHNICAL ISSUES AT DEPARTMENT OF ENERGY REACTORS, NATIONAL RESEARCH COUNCIL; AND DR. RICHARD DENNING, BATTELLE MEMORIAL INSTITUTE, MEMBER, COMMITTEE TO ASSESS SAFETY AND TECHNICAL ISSUES AT DEPARTMENT OF ENERGY REACTORS

Mr. MESERVE. Thank you very much. I am very pleased to join you this afternoon to discuss the report——

Senator WIRTH. You are going to have to pull that microphone over right close so that everybody in the room can hear.

Mr. MESERVE. All right.

I am very pleased to join you this afternoon to discuss the report released today by the National Research Council entitled "Safety Issues at the Defense Production Reactors." I am joined by several members of the committee. On my immediate left is Bill Kastenberg who is the Chairman of the Department of Nuclear Engineering at UCLA; and on my far left is Richard Denning who is with Battelle Memorial Institute. On my right is Dana Powers who is with Sandia National Laboratory. And on my far right is Steve Blush who is the Study Director for our committee.

I should also indicate that there are 12 other members of the committee, who are not with us today, but who were and have been very actively involved in the development of our report.

I shall first describe the origins and nature of the committee's work. I shall then turn to several of the issues discussed in our report. Let me note at the outset, however, that any brief statement cannot do justice to all of the matters that the committee evaluated. The report, rather than my remarks today, is the authoritative statement of the committee's conclusions and recommendations.

Shortly after the accident at the Chernobyl Nuclear Power Station in April 1986, Secretary Herrington requested that the National Academy of Sciences and the National Academy of Engineering establish a committee to examine safety and technical issues at the Department's major reactors. The report released by the committee today provides a partial response to the Secretary's request.

At the suggestion of the Department, the committee focused its attention initially on the defense production reactors, the reactors that produce tritium and plutonium for nuclear weapons. Our report covers the N reactor at the Hanford Nuclear Reservation in Washington, and the K, L, and P reactors at the Savannah River plant in South Carolina. A subsequent report, to which the commit-

tee will now turn its efforts, will deal with the remainder of the Department's large reactors.

The committee has attempted to fulfill its task in a variety of ways. We, of course visited the reactors and interviewed both DOE staff and the contractor personnel who actually operate the reactors. DOE, the contractors and others briefed the committee at numerous occasions at the sites, here in Washington, D.C., and elsewhere. The committee benefited from public hearings that it conducted in cities in the vicinity of the reactors. And finally, we reviewed extensive documentation provided by DOE and its contractors. The extent of this documentation is reflected in the 50-page bibliography which is included in the report. The committee could not have completed its study without the assistance of all those who provided relevant information.

Before turning to our analysis and conclusions, I think it is important to mention some of the things we did not do. First, the committee's efforts were confined to an examination of technical and safety issues at the production reactors. We did not examine other facilities in the defense weapons complex. Moreover, we did not examine the current or projected demand for the nuclear materials that are produced in the reactors. These matters, although unquestionably important, fell outside our charge.

The committee did not attempt to reach any bottom line judgment as to whether the reactors are safe. Such an assessment would involve a determination of acceptable risk, a matter of obvious importance, but one that is more the province of the Congress and of the DOE than of the committee. For the same reasons, the committee did not address such specific issues as whether to restart the N reactor. It must be noted, however, that the production reactors have many desirable features that serve to minimize either the likelihood or the extent of an accident. Let me list a few.

The reactors are in relatively isolated locations.

The Savannah River and N reactors have operated for over 25 years. There is extensive operating experience.

The control mechanisms enter the reactors in low pressure regions, facilitating their insertion and largely eliminating the potential for accidental ejection.

Both types of reactors have backup shutdown systems that supplement the normal control systems.

The reactors have emergency core cooling systems that can be reliably activated.

The Savannah River reactors operate at lower temperature and pressure than commercial power reactors or the N reactor and hence their stored energy is significantly lower, reducing the potential threat in an accident.

These positive features should be borne in mind as the committee's report is examined.

Despite the fact that the Chernobyl accident was the impetus for the study, the committee concluded that the Chernobyl accident could not and should not provide the foundation for our analysis. Early press reports emphasized a superficial similarity between the N reactor and the Russian RBMK reactor at Chernobyl; namely, that both use graphite as a neutron moderator. The committee concluded that our examination should be guided by issues we identi-

fied rather than any real or apparent similarities between the production reactors and the Chernobyl reactor. We were led to this conclusion because there are very significant differences between the RBNK reactor and the N reactor. Perhaps the most significant lesson from Chernobyl for the production reactors is simply that a severe accident can occur unless design and operation are approached with care and integrity.

The committee's report includes a large number of conclusions and recommendations. Although we are prepared to answer your questions on any aspect of the report, I will focus my comments on three areas that I believe have particular significance for the Congress.

First, aging. The Savannah River reactors were built in the 1950's, and the N reactor began operation in 1963. Both reactor types are beginning to experience life-limiting material aging brought on by irradiation and corrosion. This aging could affect safety and is likely to limit the remaining useful lives of the reactors.

To avoid corrosion of the aluminum-clad fuel, the Savannah River reactors operate with a coolant that is mildly acidified and contains a relatively high level of dissolved oxygen. In this environment, the reactor's high carbon stainless steel is susceptible to stress corrosion cracking in the region of welds. Although the piping in the reactors can be replaced, the replacement of the reactor tanks is deemed infeasible.

The C reactor was retired from service in 1986 when it was decided that cracks in the reactor tank could not be repaired. No cracking has yet been observed in the other Savannah River reactor tanks, and the contractor has embarked on a program to detect cracking before rupture could occur.

Nonetheless, unless a repair technology is developed, all of the Savannah River reactors may eventually have to be retired from service because of cracking problems. No one knows precisely when this may occur.

Acute aging problems also exist at the N reactor. As has been widely publicized, radiation damage is causing the graphite moderator to expand. Because the graphite growth is nonuniform, the expansion places stresses on the process tubes and cooling tubes that are interspersed throughout the graphite moderator. At the same time the process tubes are being embrittled by exposure to radiation. And gouging of the distorted process tubes during fuel insertion provides opportunities for crack formation. In short, graphite expansion is placing stresses on the hardware in the core at a time when irradiation-induced embrittlement is making the metal components less able to withstand these stresses.

As the Department has already recognized, these problems will reach a critical juncture in the 1990s when the graphite moderator expands to the point that it comes in contact with the reactor vault's biological shields. The Department has stated that it will shut down the N reactor at that time.

In sum, the N reactor and the Savannah River reactors are confronting a number of problems related to acute aging that cannot be avoided. Indeed, we conclude that the remaining useful life of the production reactors is likely to be equal to or shorter than the

time needed to authorize, fund, design and build new facilities to produce plutonium and tritium.

The contractors have comprehensive monitoring programs underway to detect a serious problem before an accident occurs, but if repairs cannot be made, the affected reactor must then either be retired or operated under circumstances in which safety is compromised. If the United States finds it necessary to have a reliable and safe capability for the production of strategic nuclear materials, then planning for new production reactors or other alternatives must be accelerated.

The second issue that I would like to discuss has to do with severe accident analysis. The main body of the report consists of an evaluation of technical issues relating to potential severe accidents at the production reactors. The committee concluded that current understanding of the behavior of the reactors is insufficient to permit a realistic assessment of the effectiveness of the reactor designs in mitigating the consequences of severe accidents, should they occur. Let me discuss a few examples.

Like commercial power reactors, the production reactors are supposed to be designed and operated so as to survive a major loss-of-coolant accident, a highly unlikely accident that could arise if the largest coolant pipe were to rupture completely. The production reactors have safety systems in place that are supposed to respond appropriately to exactly this postulated threat, and each of the reactors is meant to be operated only at power levels at which these safety systems will prove effective.

The committee found that the analyses to demonstrate the adequacies of these measures are as yet incomplete at both sites. We, therefore, recommend that substantial efforts be undertaken to develop a thoroughly documented understanding of the behavior of the reactors in the event of a loss-of-coolant accident.

I emphasize that the committee's recommendations in this area deal with the need for analyses to validate the adequacy of the reactors. We have not concluded that the reactors as currently designed and operated will fail to respond adequately.

The production reactors differ from commercial power reactors in their use of confinement systems rather than reactor containments as barriers to the release of radionuclides. A confinement system aims to control the effluents that would be generated in the event of an accident by releasing contaminated air within the confinement structure through filters that capture some of the radionuclides. A containment system, by contrast, which is used on commerical reactors, is intended to contain substantially all of the radionuclides.

The committee concludes that in theory the confinement approach can provide an acceptable means for mitigating the consequences of accidents. We found, however, that there are significant uncertainties about the ability of the existing production reactor confinements to mitigate the effects of a severe accident.

For example, the design and operation of the filtration systems are obviously crucial, but their effectiveness is dependent on the types, amounts and sizes of the particles that would be generated. Research with commercial nuclear power plants, as well as studies of radionuclide release from the Savannah River fuel, suggest that

some of the assumptions used in the design of the filtration system may be unrealistic.

The committee, therefore, recommends that the Department demonstrate that the confinement systems at the production reactors have the capability to withstand realistic accident loads and to provide acceptable attenuation of radionuclide releases in the event of a severe accident. Moreover, careful consideration should be given to the possible evolution of hydrogen in an accident and the need to assure that hydrogen deflagration does not threaten the confinement.

Let me turn now to the final principal issue. Although the committee focused its attention on a series of technical issues, we also examined the management system that is in place to assure safe operation. Let me first discuss DOE's relationship with its contractors and then turn to some of the committee's recommendations for changes in the current management systems.

DOE, like most of the commercial nuclear industry before the mid-1970's, has focused its analysis efforts until recently on assuring that its reactors could respond to design-basis accidents, postulated accident scenarios that are deemed to be unlikely but credible. Consistent with the effort in the commercial industry, the committee urges that the Department consider a wider range of possible accidents.

Among other possible accident scenarios, for example, the committee examined whether the production reactors were susceptible to a power excursion. The Chernobyl accident arose in part because the RBMK reactor is unstable. An increase in power in the RBMK reactor causes further increases to occur. In discussions with the contractor, the committee found that if a severe accident were to occur at Savannah River, one could imagine a subsequent set of conditions that might result in a power excursion. If an accident involving blockage of fuel flow followed by failure of the scram system, which is the reactor shutdown system, were to occur, particles of molten fule might be swept up into the core moderator space and lead to propagation of melting in a subsequent power excursion. The committee recommends that the ongoing analyses of the plants include an examination of the risk of this accident scenario.

It must be noted in this connection, however, that this hypothetical scenario and the Savannah River reactors differs from the Chernobyl situation. The RBMK reactor at Chernobyl was inherently unstable and susceptible to a power excursion as a result of its design under normal operation. A similar excursion could possibly arise at the Savannah River reactors after fuel blockage, a failure to scram and subsequent melting, in particular target or fuel assemblies.

The likelihood of such a set of circumstances at the Savannah River reactors is remote, and even if they were to occur, the seriousness of the problem has not yet been adequately evaluated. I emphasize these differences because I do not want the committee's comments on the possibility of a power excursion to divert attention from the more important issues that are discussed elsewhere in the committee's report.

This leads me to the third and final principal issue. Although the committee focused its attention on a series of technical issues, we also examined the management system that is in place to assure safe operation. Let me first discuss DOE's relationship with its contractors and then turn to some of the committee's recommendations for changes in the current management system.

The contractors responsible for the operation of these reactors have excellent records of safe operation. Perhaps partly because of this record, we found that DOE has tended to defer to the contractor's expertise and to rely on their efforts to identify, evaluate and resolve safety issues. The DOE staff assigned to safety oversight of the reactors is small and lacks a depth of technical experience commensurate with that of the contractors.

Although the Department must allow its contractors a degree of technical discretion, the committee believes that DOE's involvement should be sufficiently comprehensive as to allow it to evaluate all aspects of the contractor's performance. The committee recommends that DOE augument the resources and talent it assigns to ensuring the safety of these reactors. Moreover, we recommend that the Department enhance its ongoing efforts to strengthen its internal safety organization, which is environment, safety and health, so as to assure effective and comprehensive safety oversight.

In addition, we found that the safety oversight of the reactors has been ingrown and has been conducted largely outside the scrutiny of the public. Indeed, we considered whether the safety responsibilities now assigned to the Department should be transferred to the NRC or some analogous new entity created outside of the Department. We concluded that the Department can accomplish the reactor safety functions that are assigned to it if it dedicates itself to the task, but in our view an independent and aggressive oversight committee is needed to assist the Department and to build public confidence that the reactors are being operated to high safety standards.

Among other features, the committee should be made up of members of recognized stature in reactor safety, should include individuals from outside the DOE community, should set its own agenda, should have thorough review authority, and should be assisted by a full-time staff.

Our major conclusions and recommendations may be briefly summarized. While we did not determine whether the production reactors are safe or unsafe, we did identify a number of important safety, technical and management issues that should be addressed. The reactor facilities are old and are showing the inevitable signs of aging. Their useful operating lives are likely to be limited regardless of any technical fixes that may be employed. Current understanding of how the N reactor and the Savannah River reactors would behave during severe accidents is not complete and should be developed promptly. Management and safety oversight for the reactor facilities should be strengthened through more detailed review by DOE safety personnel and by establishment of an aggressive, independent oversight committee.

Many of the issues identified by our committee have already been recognized by DOE and its contractors. The Department has

taken steps to respond to some of our concerns and their willingness to do so is welcome. Our hope is that the conclusions and recommendations presented in our report will serve to bolster and sustain current efforts to ensure the safe operation of the Nation's defense production reactors.

My colleagues and I will be happy to respond to your questions.

Senator WIRTH. Thank you very much, Mr. Meserve. Do any of your colleagues have comments that they might like to make at this point?

Mr. MESERVE. Any comments?

[No response.]

Senator WIRTH. Thank you very much. Let me, if I might, take a few minutes and then defer to Senator Evans.

How long do you estimate it would take to authorize, design and build a new reactor?

Mr. MESERVE. Your estimation of that may be as good as mine, Senator, in that part of the process would involve not only design review and the development of design, but authorization and appropriation of funds. These days I believe the average time for the construction of a commercial nuclear power plant is 12 years. It is hard to imagine that the construction of a new production reactor, it that's the route that is chosen, would take less time in that a production reactor would have a different design, would be unlike a commercial plant, raise issues of design that have not yet been confronted.

Senator WIRTH. So, we're looking at a minimum of 12 years, probably more. And is that a consensus, do you think, within the scientific community and technological community?

Mr. MESERVE. I'm not sure what the consensus in the scientific community would be on that issue.

The real problem is on the other side of the equation, which is how long can we count on the existing production reactors to be able to continue their operation.

Senator WIRTH. You're answering my second question. How long is that, I'm after this gap. How big is the gap?

Mr. MESERVE. Well, that's something that unfortunately science does not enable us to say. At the N reactor we realize that the graphite expansion problems are going to result in the graphite reaching the reinforced concrete housing that surrounds the reactor some time in the early to mid-1990's.

Senator WIRTH. So, we can't count on Hanford to bridge the gap if a new reactor doesn't start for at least 12 years.

Mr. MESERVE. That's correct.

Senator WIRTH. Probably Hanford is out of the equation. Is that right?

Mr. MESERVE. That's correct.

The Savannah River plant—the issue there is when would a crack likely occur in the reactor tank. And all of these tanks are susceptable to cracking. But we are unable to tell you when that will occur. And that could occur—is inevitably going to occur. But there is no way——

Senator WIRTH. Who can make the judgment if we can safely bridge the gap between the existing reactors and the time that a new reactor might come on line? You are not talking to a lot of

technical experts in the United States Senate. Although some would sound that way, I can assure you there aren't very many who are.

Mr. MESERVE. It is a matter of judgment. It is not something that the committee or any group could sit down and calculate for you and give you a precise——

Senator WIRTH. What's the range of judgments?

Mr. MESERVE. And it was the sense of the committee that the advance that we should give the American public is that the time it would take to establish a new production reactor or alternative is likely to be longer than the time of the remaining life of the existing production reactors.

Senator WIRTH. And what's the "therefore"? It is your best judgment that that gap exists and that we are going to be stuck with it. So, what do we do about that?

Mr. MESERVE. The therefore and the recomendation of the committee is that we face up to this issue very promptly and accelerate—if the conclusion is that we continue to need these materials, then we should start to address this issue now so we are not confronted with the dilemma where there is no other alternative.

Senator WIRTH. Were you surprised that this gap was there?

Mr. MESERVE. I am really not in a position to judge that.

Senator WIRTH. Is it fair to generalize about the discussions of the committee in looking at this? Were you surprised that we have gotten ourselves into this situation?

Mr. MESERVE. I'm not really capable of answering that question. We really addressed the situation we found and didn't attempt to go back and see how we had gotten in that situation.

Senator WIRTH. What else should we ask the National Academy to look at? As you may know, I am familiar with one of the support complexes which is Rocky Flats where plutonium is machined and reprocessed. I think we have some very significant problems there. We have a whole transportation network. I would suggest if the kind of analysis employed by your committee in looking at the production reactors were applied to the transportation network, we would find some pretty egregious problems.

And in part, I'm answering my own question, but did you all, as you looked at the plants, say, hey, wait a minute? There are a whole lot of other facilities that relate to this. Maybe we ought to be looking at those. Should we charter the Academy to do that? Should we ask DOE to do that? Did you all have any reaction to that?

Mr. MESERVE. The committee was a committee of volunteers, and we had our plate full in dealing with the production reactors, which was the issue with which we were presented.

Senator WIRTH. I understand.

Mr. MESERVE. We did not confront other elements of the defense weapons complex. So, for example, we never visited or had any reason to investigate anything having to do with Rocky Flats. So, we really don't have any expertise that we can provide to you or give you any guidance with regard to that situation.

Senator WIRTH. As you, however, were having coffee before or afterwards or whatever, you must have looked at each other and quite naturally said, hey, wait a minute. If this exists over here,

isn't it logical to assume this problem is not unique—the failure to anticipate the need for rebuilding this complex—and we might find the same sort of things elsewhere? I'm not trying to put words in your mouth, but I would think that that would be a logical set of discussions to have.

Mr. MESERVE. Well, we both would be speculating on that I guess. And we didn't look at it. And certainly as the committee, I can't comment on the situation elsewhere.

Senator WIRTH. We have heard a great deal of testimony on this issue. Not only are these hearings being held by the Energy Committee, but the Armed Services Committee on which I also sit has been having extensive hearings on the issue of the complex. And the figure of $100 billion to replace the whole complex is one that has been pretty consistently used and pretty comfortably used without a lot of contradiction. I mean, maybe we are plus or minus 10 percent on one side or the other, but it looks to me, at least listening to this testimony and being familiar with this issue before, that we are looking at a figure of $100 billion, today's dollars, over the next 10 to 15 year period of time.

Does that surprise you? Is that consistent with what you would extrapolate from your analysis in this area?

Mr. MESERVE. We looked at the existing reactors and addressed the safety and technical issues as we saw them associated with those reactors and did not concern ourselves quite frankly with financial costs that would be associated with their replacements. We did not look at any issues as to what sorts of facilities might be appropriate to replace these reactors.

I should tell you, Senator, that there is another Academy committee that, as I understand it, has been created to look at some of the issues associated with a new production reactor. But that's not us.

Senator WIRTH. Finally, Secretary Herrington, this morning in response to your report announced the creation of a safety advisory panel. And you're familiar with that panel that would be appointed by the Secretary and instructed to report to the Secretary.

In light of DOE's record on monitoring and protecting safety, the record that your report so well focused on, do you think that the residents living near the N reactor at Hanford or, say, near Rocky Flats in my own backyard would have confidence in the independence of such an advisory board?

Mr. MESERVE. Well, I think that if—I have not seen the detailed description of the advisory board that the Secretary has indicated that he would create. We thought it was very important that such an advisory board have membership on it with people who have recognized stature in reactor safety for one thing, but I also I think it is important that you have people who are outside the DOE community who are participants on that. And that helps to serve this credibility function that you have alluded to, but also serves an additional function in that there is a lot of learning that has been generated over the years in connection with commercial reactors. And it was our judgment that some of that knowledge and information having to do with the way things are going in the commercial reactors could be productively applied in the production reactors and has not, and that having some membership from outside the

DOE community on this advisory committee could serve both purposes of restoring public confidence, and then secondly, having some useful cross-fertilization.

Senator WIRTH. I guess one of the crucial issues that we are going to face is looking at the authority that such a committee ought to have. One of the concerns is that people might not have confidence in an advisory panel that did not have any authority given a DOE that has a history that is, let us say, somewhat checkered on the issue of safety and health. If you have an advisory committee that doesn't have any authority, why would one expect then that DOE would follow through and do anything about what the advisory committee suggested? That is a perfectly logical question to ask.

And in response to that, two different kinds of suggestions have been made; one, under Senator Glenn's legislation that that advisory panel's recommendations be elevated above the DOE Secretary, directly to the White House to the President, if the Secretary rejects the recommendations. Now, that's one suggestion that has been made to give such an advisory group teeth.

A second has been to transfer some of the responsibilities out of DOE and get out of the fox and chicken house syndrome that characterizes perhaps much of the oversight of DOE health any safety standards and DOE environmental standards, to move those out, say, to the National Institutes of Health, National Institutes of Cancer Research or to the EPA.

Do you have any reaction to the authority issue and how that might be handled? Or would that concern you?

Mr. MESERVE. The recommendation that we have has an element that I may not have emphasized adequately in my statement that has to do with the fact that we think that this advisory committee ought to operate to the extent possible in the open, in the public eye, for the reason that—I mean, it's my personal view—that if an advisory group of stature were to report to the Secretary that there were serious safety issues that they felt concerned them, that that would provide enormous leverage that as a practical matter could not be ignored by the Secretary.

Senator WIRTH. So, your sense of openness is really the leverage that is needed to make things happen.

Mr. MESERVE. As a practical matter, I think it would have that effect.

But we acknowledge, and we acknowledge in the report that this is a recommendation which sort of builds on a system which exists today and which has been strengthened, quite frankly, over the last year and a half in ways that we think are very productive. But if over the course of time you discover it was not operating adequately, that the answer would be to adopt some more radical measure. And proposals you mentioned might be the next step if this doesn't work.

But our recommendation really builds on the existing system and I think would be minimally disruptive of that system, and really is something that we were driven to in part because of the very substantial strides that I think have been made in the Department over the last year and a half, starting before Chernobyl, to strengthen their capabilities in terms of oversight. I am not saying

that they are there. We have many recommendations for greatly strengthening that system that exists today, but they have made strides. And it is important to recognize that.

Senator WIRTH. Well, Mr. Meserve, you are a very good witness, and the quality of your testimony and the quality of your presentation are a reflection of the quality of the report presented by you and your group. And we are deeply indebted to you and your colleagues for your great help in this area. We thank you very much.

Mr. MESERVE. Thank you, Senator.

Senator WIRTH. We have been joined by Senator McClure who, as you know, has a longstanding interest and an extraordinary amount of expertise in this area. Senator McClure, we are delighted to have you with us. We apologize for getting going, but we finally decided to go ahead. Although we did want to wait for your august presence before starting, we thought we would get ahead.

Senator MCCLURE. Well, thank you very much. I am pleased that you went ahead. And I am apologetic for having been late in arriving. There are very few events that would have kept me away from this hearing at this time with this group. One such event was when the President of the United States called and indicated that he would be pleased if I would attend as he was making the announcement of his nomination for the Supreme Court. And having a request of that kind is not only a command but an opportunity. [Laughter.]

And I went as he announced the nomination of Judge Douglas Glnsbug of the Circult Court of Appeals in Washington, D.C. to be an associate Justice of the Supreme Court of the United States, an important and significant event. But it took something like that to keep me away from this opening.

However, Mr. Chairman, since Senator Evans was not late and I was, I would suggest we defer to him at this time.

Senator WIRTH. Thank you, Senator McClure.

The President did not ask me to come to that event. [Laughter.]

Senator Evans.

Senator MCCLURE. No. But he did ask me to ask you for an affirmative vote. [Laughter.]

Senator WIRTH. Senator Evans.

Senator EVANS. Let me begin with the concern that you have expressed in response to questions by the Chairman that we are likely to—and I understand that it is impossible to say for sure, but we are likely to run into a circumstance where the four existing reactors will, because of age an infirmities, be closed down before we are able to design from scratch a new reactor and put one into place for military production. Is that a reasonable restatement of your testimony?

Mr. MESERVE. That's right. I think it really should be characterized as that there may be a gap. We don't know for sure that it will exist. I would hate to have the record reflect that we have an affirmative statement that we know there will be a gap, but that there is that likelihood.

Senator EVANS. I understand that you have not looked into this. You were not look into it. But would you judge that if that looks more and more like it is the case, that it would be a prudent thing

to do to at least look at an alternative that might bring a new production reactor on faster than 12 years?

Mr. MESERVE. We really has no occasion to look at that. I think it is implicit in our statement that there may be a gap that one should move forward quickly to address some means to produce these materials. We did not have any occasion to look at the issues that might arise as to how one would proceed to do that.

Senator EVANS. I'm not suggesting that you should have any particular detailed knowledge, but from your background or the background of any members of the panel, is there any technical reason at least why the completion of the WNP-1 reactor, an abandoned reactor at the Hanford Reservation, could not be completed to fulfill production requirements for the military?

Mr. MESERVE. Again, as a committee, we certainly didn't look at that question.

Senator EVANS. I undertand that. I was just wondering if there is—

Mr. MESERVE. I don't have a view of that as a personal matter.

Senator EVANS. Does anyone on the panel today have a view just in terms of the technical aspects of whether it——

Senator MCCLURE. Would the Senator yield for just one?

Senator EVANS. Yes.

Senator MCCLURE. I think it is a word of art, and perhaps lawyers are more conscious of that than engineers. I don't think the term "abandoned" Is technically correct with respect to plant.

Senator EVANS. I'm perfectly aware of that. As the power council that I chaired that put it in reserve, I am aware that it is still carried at least on the books as a potential asset of the Pacific Northwest power grid. However, from the knowledge of the work we did in the needs for power in the future, I use the term "abandoned" advisedly. I understand that it is technically not abandoned, but I wouldn't want to lay any money on the fact that it will be completed for civilian power purposes.

Senator MCCLURE. Well, I understand that. While the Senator from Washington is the Senator, I wouldn't lay any odds he is going to run for reelection.

Senator EVANS. Let me turn to some of the specifics in the report starting with chapter 2 and going through at least a few of the aging phenomena so we all understand better what we are doing. The aging phenomena, of course, I think you have spoken to. Could you be a little more specific in what appear to be the most significant problems? I think we know at the N reactor at least the swelling the graphite is of if not a time certain, at least a time limiting function that we are fairly well aware of.

What are the most likely problems at Savannah River besides cracking of the vessel itself?

Mr. MESERVE. We identify the cracking as being a particular problem that the Department has recognized as one for which there is not a fix. The other components of the reactor are ones which are susceptible to being replaced if you detect a problem.

I would turn to Dr. Powers to see if there is anything beyond the cracking of the vessels which is something that is an aging phenomenon associated with the Savannah River plants that is not repairable.

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Dr. POWERS. I think you have properly characterized it.

Senator EVANS. Is one of the difficulties—and I know you mentioned the difficulty of currently having only visual identification of cracking. And while we do that on a regular basis for our commercial aircraft—we look visually—we also go beyond that and look ultrasonically or through x-rays and other more sophisticated ways to determine potential, nonvisible cracks. Is there a way to do that at Savannah River?

Mr. MESERVE. Go ahead.

Dr. POWERS. Yes, sir. They are developing ultrasonic techniques and are evaluating the possibility of using any current techniques on these reactors. It is a development effort that is getting fairly well advanced. And we explicitly note our encouragement that that be carried on because it supplements visual identification of flaws so very important to the leak-before-break strategy that they are pursuing there.

Senator EVANS. Does full power operation or advanced power operation of these reactors at Savannah River potentially exacerbate the problem or potentially lead to a faster development of stress corrosion cracks?

Dr. POWERS. The operational effect is one to cause irradiation embrittlement of the metal which would make it less fracture tough. The Savannah River contractor operates his calculations using an extremely conservative estimate of that fracture toughness so that in fact that operational effect is one that is accommodated for in their leak-before-break strategy.

Senator EVANS. Now, that toughness is one that is purely from calculations rather than testing?

Dr. POWERS. No, sir. They have done experiments with materials up to about the irradiaiton history they have now with the—or maybe slightly beyond the current irradiation history. They have been able to do experiments on fracture toughness. To extrapolate beyond that, they are trying to do experiments. There was a reversal in getting that experimental data because of the shutdown of the Oak Ridge reactors. So as a result, they have had to just operate with conservative estimates of how fracture toughness might evolve with irradiation.

Senator EVANS. But even in the experimental phase of that, it is not from being able to take any particular operating piece out of the reactors and testing it. It is from taking other similar metals, subjecting them to some kind of equivalent radiation, and then making conclusions from that?

Dr. POWERS. They have, in fact, been able to do both. And there is another retired reactor at the site, the R reactor. They were able to remove sections of metal from the R reactor with its radiation history and conduct metallurgical tests with that, as well as doing tests with specimens of similar metals exposed to what you would call laboratory type effluences.

Senator EVANS. At the N reactor, as I understand it, the focus is on the various tubes and their brittleness and how they may be subject to failure. I understand that they are now in the process of examining a share of those tubes and subjecting at least a few of them to destructive tests to see whether they are approaching the

brittleness. It is my understanding that at least to date they have found no significant failures in the ductility and the——

Mr. MESERVE. I think it is clear to say that there has been no failure of a process tube at the N reactor.

Senator EVANS. Yes.

Mr. MESERVE. They have found cracks in the process tubes as a result of their inspection program. And some of those cracks were deeper than they had anticipated that they would be. And that is the reason why they have accelerated and expanded their inspection program.

Senator EVANS. You are suggesting that that be expanded to 100 percent examination. At least I think you used the words "worthy of consideration." Would that be in your view a prerequisite to reopening the N reactor or something that could be conducted during the shutdown, the regular shutdown periods, when it's operating?

Mr. MESERVE. We did not address issues having to do with restart or the time that would be required to really conduct that. That might be something that you would want to move forward expeditiously. If the N reactor was started, you would do the extensive examination program during the periods of periodic shutdowns. That really was not something that—restart issues were not things that the committee viewed. One of the important elements in that whole equation, of course, is the need for the materials, which we didn't look at.

Senator EVANS. Let me turn to your third element in your chapter 2, the power operating limits. You have lowered those power operating limits at Savannah River. They have lowered; the operators have lowered them twice, and the second time down to the 50 percent level which I understand you are recommeding they maintain until such time as further studies and knowledge is available prior to bringing them back up.

You say before restoring full power operation that it has a thorough understanding of the behavior of the Savannah River reactors in a loss-of-coolant accident. Is there a fear that in a loss-of-coolant accident that there may be a power—I guess what you use is the term "power excursion"?

Mr. MESERVE. That is not precisely correct, Senator. What we are dealing with here is—the loss-of-cooling accident that we are talking about is one of the design-basis accidents for this plant which you assume for purposes of the analysis that the largest coolant pipe that flows into the reactor is catastrophically destroyed or just eliminated, presume it's not there. And the reactor is intended to be designed and operated such that it can survive that incident by having safety systems that provide coolant flow.

The power excursion accident that I mentioned in my testimony that we are dealing with is an accident scenario that would involve the blockage of some of the flow, coupled with a failure of the scram system, which is the shutdown system, the rods that move into the reactor that turn off the nuclear reaction. And a circumstance that could arise there is if you had fuel melting and the particles of fuel move back up into the presence of other fuel elements or target assemblies and have further melting that could lead to a power excursion. It is a different accident scenario than the loss-of-coolant accident.

Senator EVANS. Perhaps I was mixing the two of them. You are referring to the statement which is on page 38 that says, "However, in 1958 melting experiments performed on Savannah River fuel tubes in the SPURT reactor in Idaho led to the identification of a potential mechanism by which positive reactivity insertion could occur in the Savannah River reactors in a severe accident."

Mr. MESERVE. Thats the latter, the power excursion accident that I described, which involves a series of steps that would occur in that accident scenario.

Senator EVANS. Would you describe again for the record so it is clear to everyone the distinction—I guess we understand more or at least the general public I suspect understands more the similarities, if any, between the Chernobyl and the N reactor or other reactors in the United States, and have a very limited knowledge of the differences. Would you care to describe briefly for a layman? And I consider myself a layman even though an engineer because it wasn't my kind of engineering.

Mr. MESERVE. There are several important differences. There were early reports that the RBMK reactor, which was the Russian reactor at Chernobyl, had similarities to the N reactor. And that was because they both use graphite as a moderator.

One of the design differences which I mentioned in my testimony had to do with the inherent instability of the RBMK design that once the boiling started to occur in that reactor, the design was such that the power of the reactor tended to go up, which induces further boiling. The design of the production reactors in the United States is such that it has a negative feedback result. Once there is a power excursion, it tends to be dampened that the voiding, in fact, causes a power reduction. So, it's a much more stable system.

There are other features that are important. There is one that I might mention is that the RBMK reactor had very slow moving control rods, which were these rods that come down into the reactor and turn off the nuclear reaction. Those were very slow moving, and in fact, because of their design when they were initially inserted, they tended to increase the reaction. They had a positive effect again. That's a very undesirable feature.

Both of these reactors—both types of reactors that we are talking about here, the production reactors—have very fast operating control rods. They don't have this problem about a positive effect as they are initially inserted. And moreover, both the Savannah River reactors and the N reactor at Hanford have completely independent shutdown systems so that even if the normal system does not operate, there is a second system that can be used to turn off the reactors.

Senator EVANS. And that second system did not exist in the Soviet reactor?

Mr. MESERVE. That's correct.

Senator EVANS. So, I guess in more technical terms, what you have just described as a characteristic of the Chernobyl reactor is the penchant for positive reactivity. Is that the term?

Mr. MESERVE. That's correct.

Senator EVANS. And that that is not a—

Mr. MESERVE. And certain problems——

Senator EVANS [continuing]. Very likely scenario in either the N reactor or the Savannah River reactors although potentially under a defined set of circumstances, at least you report that it could occur at the Savannah River reactors and possibly I suppose at the N reactor as well.

Mr. MESERVE. It's very unlikely. These reactors are designed so they do not have that positive reactivity effect.

Senator EVANS. You mentioned the need then in your recommendations that thorough understanding—let me get both of them here together. You used some different terms. And I'm a little curious about the different terms in respect to the two reactors. On page 28 in the recommendation you say, "The Department of Energy should insure that before restoring full power operation at Savannah River, it satisfies itself on the basis of a rigorous, external review, that it has a thorough understanding of the behavior of the Savannah River reactors in a loss-of-coolant accident." On page 31 on the N reactor, you say a thorough understanding of the behavior of the N reactor in a major loss-of-coolant accident should be urgently developed." Is there a reason for that to be—the word "urgently" to be used in one place and not the other?

Mr. MESERVE. I think that that may be a reflection of the fact that there is a very substantial program that is under way at the Savannah River reactors that in order to understand exactly this issue, there is a large program planned that the committee had the opportunity to review, a program that is under way, and that they are, in fact, at the Savannah River plants developing this understanding. And the recommendation, therefore, focused on how the results of that ongoing work should be used.

At the N reactor they also have a program under way. I think it is perhaps fair to say the sense of the committee that there were a number of technical issues associated with that analysis that we describe in the report. And we have some recommendations that are in the text of the report as to the nature of the problems that they are confronting, and we have some ides on how they might focus and improve their effort.

Senator EVANS. In essence, you are talking about various levels of probability of risk assessment as a major tool for that understanding?

Mr. MESERVE. This particular problem has to do with the series of computer codes that are used in the analysis that are very complicated codes that have to do with the fluid dynamics problems associated with this particular problem and a whole series of other issues.

Senator EVANS. But those are the elements of the codes that go into an overall probability of risk assessment.

Mr. MESERVE. That's right. That would be one element.

Senator EVANS. With the various levels of probability risk assessment, could you tell us about what you are talking about in terms of the length of time that you anticipate to be required before they can be developed and whether all-I guess, there are three levels of probability risk assessment—whether all three levels should be completed before either the N reactor is restarted or the power is increased at Savannah River? How do they integrate with changes in operation?

Mr. MESERVE. They don't necessarily integrate in any way in which there is causal linkage between completion of——

Senator EVANS. Well, I know there is not a causal linkage. But in your view in terms of the wisdom of operation, are these absolutely necessry to complete at one, two or three stage before any change in operation is accomplished, or is that the judgement or what?

Mr. MESERVE. No, that was not the judgement of our committee that decisions as to operations should necessarily be hinged on the completion of those.

We did urge that the level one and level two PRAs that are currently under way in connection with both reactors be completed as quickly as possible and subjected to peer review. The PRA analyses are very important not only because they give you this risk estimate that we have been talking about, but also the process and the discipline of going actually through the assessment can lead you to understandings that you might not ever otherwise have. And that probably is the most important benefit of undertaking a PRA.

Senator EVANS. Turn to hydrogen generation and mitigation. In your conclusions you say, "The committee's overall assessment of the approach"—this was the approach for hydrogen mitigation at the N reactor—"is favorable. However, there are aspects of the underlying analyses and potential limitations of the proposed system that deserve careful evaluation." Are there any one or two or several important elements of that further analysis that you would like to comment on?

Mr. MESERVE. Perhaps I ought to call on Mr. Denning, who has spent a lot of time on the hydrogen mitigation issue, to comment on that.

Senator EVANS. Fine.

Dr. DENNING. Why don't you repeat the question again?

Senator EVANS. Well, on page 42 in the conclusions you say, "The committee's overall assessment of the approach is favorable." And that's the approach for hydrogen mitigation which has been chosen at Hanford. "However, there are aspects of the underlying analyses and potential limitations of the proposed system that deserve careful evaluation." I wondered if you, for the record, would like to speak to whatever are the most important of these aspects that you mention.

Dr. DENNING. Or Dana may want to. I have a hard time selecting any two or three that I would really highlight. I think that our overall evaluation was a favorable one. There are a handful of areas in which we have recommended further work be done.

Senator EVANS. Well, let me rephrase the question.

Dr. DENNING. Yes.

Senator EVANS. It may have been an inaccurate or an unfair question.

Would you consider that these extra—and now you say overall is favorable. The aspects deserve additional careful evaluation. Are any of those cause for significant alarm or concern about the development in a timely fashion of the hydrogen system?

Dr. DENNING. No, I don't think so. There are some that are undoubtedly more difficult for the contractor to deal with than others. We had some questions about the magnitude of the hydrogen source term that was used for the design basis. There are some

uncertainties about some of the mechanisms that can potentially lead to hydrogen production in the accident scenarios that they analyzed and in other accident scenarios that they didn't analyze. So, we felt that we would have liked to have seen a broader spectrum of accidents analyzed.

On the other hand, as we evaluated the potential of that system, it appeared to us that it did have a fairly substantial margin beyond the design basis accident that they had actually considered. I think that is perhaps the most outstanding single issue.

Senator EVANS. There's an interesting conclusion on page 45 on Savannah River. It said that "The improved confinement system currently under development at Savannah River may cause a buildup of hydrogen in the event of a severe accident." Would you explain a little more of just how you, for the record, feel that that could come about and what can and should be done about it?

Dr. DENNING. Yes. Shall I comment again on that, Dick?

In that particular case there is an improved confinement system which would attempt to filter not only some of the radionuclides that are fairly easy to filter, but would also attempt to trap some of the noble gases that are very difficult to filter so that the type of confinement that they would get would be better—that is, that in an accident that the amount of radionuclides that they would be able to capture a bigger share of those. In doing that, they have to reduce the exhaust rate of the gases to the environment. By doing that, they would have more hydrogen buildup within the confinement; whereas in the normal situation that exists as it is currently configured, a lot of the hydrogen that would be produced would be exhausted to the environment rather than held up within the confinement system.

Now, the reason that was of some concern to us is that the confinement system appeared to us to be a reasonable alternative to contrainment as long as you can provide assurance that you won't get a rapid pressure pulse that could potentialy fail that confinement. In the analyses that are done at Savannah River of hydrogen production, they don't calculate that there would be enough hydrogen to a lead to a burnable concentration so that they weren't really about hydrogen buildup.

Again, the committee members looked a broad range of scenarios. We are concerned about the adequacy of the data base. We are concerned that perhaps there is a possibility of a larger hydrogen production and that with this modification that they were suggesting or in the process of designing, that they would actually tend to hold up the hydrogen, perhaps increase the possibility of getting to a deflagrable, a burnable, concentration of hydrogen and perhaps leading to a burn that could fail the confinement.

It doesn't necessarily mean that we thought that would happen, but we were concerned that in attempting to reduce what was already not a very large release, that they might actually lead to a situation in which they could inadvertently get to a situation where it would, indeed, lead to bypassing of the filter system. We weren't recommending they they not do that; we were recommending that they look at it more carefully, taking into account perhaps the uncertainties in hydrogen production better than they have up to this point.

Senator EVANS. You talked about the problems of radioactive liquids at Hanford and at Savannah River I guess in both cases, as a result of an accident at Hanford as the result of normal operations and the problems. You said means should also be found to prevent the direct discharge of contaminated liquids. Did you have any recommendations as to how best that can be done? Or is that a common practice elsewhere than can be copied here? And if so, do we have a different set of circumstances with the nature of the effluents from a military production reactor then we do from similar effluents, if any, at a civilian reactor?

Mr. MESERVE. The committee did not attempt to define the means, and we did not want to confine the Department to any particular approach. We thought this was something that should be addressed—it defeats the confinement principle, in fact.

Dana, do you have any suggestions as to a short list of means that would be the kinds of things that would be leading candidates?

Dr. POWERS. Particularly under accident situations, I believe the contractor has considered some alternatives, including trying to do rapid ion exchange to creating sumps that would simply retain the effluent under accident conditions. So, it is my own opinion that this is not beyond the imagination of a good designer to come up with a solution to this problem.

Senator EVANS. You mention that it is a problem at both locations in case of an accident, that it is a problem in normal operation at Hanford. What happens to those similar liquids at Savannah River during normal operation?

Dr. POWERS. I believe that they capture their liquids within their confinements and retain and eventually recycle them.

Senator EVANS. Some share of them go into what would be liquid wastes and are then reprocessed. They now have apparently a vitrification plant at least being tested, if not fully run. That is the ultimate end of those things that cannot be reprocessed?

Dr. POWERS. It sounds very reasonable. I don't think I have looked at that myself.

Mr. MESERVE. I'm not sure.

Senator EVANS. Thank you, Mr. Chairman. Thank you for a very informative set of answers. Thank you.

Mr. MESERVE. Thank you.

Senator MCCLURE. Again, I apologize for having not been here at the beginning, but I will direct that my opening statement be inserted in the record following that of Senator Johnston.

I want to return to that, though, because it lays a groundwork for some of the questions that will follow, and I would also invite members of the panel to agree or disagree as they have the opportunity to do so with any of the statements I make, if you feel moved to do that, because the value of the panel is very great, and it is best expressed, if indeed we have a record that is complete and accurate, as you see it because we have been awaiting this report for a long while. It was initiated because of a series of extraordinary events dealing with the Nation's production capacity for nuclear materials for the weapons program.

Just two years ago we had five operating production facilities. Five. And all five were needed for our production capacity. Since that time the C reactor at Savannah River has been shut down per-

manently. The N reactor has been shut down temporarily. Some believe permanently but at least within the plans of the Department of Energy and the Department of Defense that production facility is needed and should be restarted. I have some skepticism about whether it will be. But that's two of the five. The other three production reactors at Savannah River have been reduced to 50 percent operating levels. We have the equivalent now, two years later, of one and a half reactors where we had two years ago five.

I emphasize that point because there is a need for material to meet the security requirements of this country and for reasons which are being analyzed. We have seriously damaged our capacity to meet the materials requirements for our country.

Now, I could go into a long history of how we got here or what we might have done to have avoided being here or alternative steps that should have been taken, some of which I urged very strongly over a period of time, but were not taken for a variety of reasons. But you can't recapture time, and you can't redo decisions that were made that have brought us to this point. We deal with a situation which does now exist.

The contributions that you are making are immeasurably important to us, but it is also very important we understand what you are saying so that we neither miss the points that you are making nor overstate the points that you are making so that they come to mean something that you did not say. And there's a very great danger in that last point because you have been very careful to say what it was you did look at, and what it was you did not look at, and what recommendations you feel qualified and comfortable in making, and other areas which you did not analyze or did not come to conclusions about upon which you have no recommendations or no finite opinion.

I say that because already we see some comments about information that for whatever reason was made available or became available prior to the release of your full statement. And this is the public's first opportunity to have you explain your full statement and for the public to see your full statement and your opportunity to make the record very plain.

I think it is important for us to understand that Savannah River reactors will continue to operate absent the kind of event that occurred with the C reactor. We are not going to deal with the best of all possible worlds because we have no alternatives. We are not going to do the best that we are capable of doing because we don't have time to do the best that we're capable of doing. We must find a way to keep the reactors operating even if it is at less than the most desirable or most optimum practices during the period of their operation.

We are going to make every effort to assure that these reactors operate within acceptable margins of safety. And you were asked, and you have responded, to try to define what should be done. And certainly you are being asked also to make comments with respect to what are acceptable margins of safety. Some of those comments you candidly say you can't respond to. I think, however, the record that is being made here is essential to a public understanding of the limitations of what you have analyzed and what you can say and perhaps also the limitations on options of this government

with respect to the operations of these plants in meeting the security requirements for this country.

I think perhaps, Senator Evans, you and I had better go vote.

Senator EVANS. I that's probably a good idea.

Senator MCCLURE. If you gentlemen are not pressed for time, we will recess very briefly while the Senator and I go and vote on the roll call that is under way on the floor, and we will return for some further questions.

Mr. MESERVE. We would be happy to await your return.

[Recess.]

Senator MCCLURE [presiding]. The committee will come to order.

Let me shift from the general comments that I had made and shift to some specific questions. And if in the process any of you wish to make comments that would correct the record as you see it with respect to comments that I have made, I would invite that as well.

You point out that DOE's stated safety approach is at a minimum comparability to the safety standards of the commercial reactor sector. How effectively do you think DOE has implemented this safety approach?

Mr. MESERVE. Well, chapter 1 of our report really deals with that issue, and we had a hard time understanding how comparability as a goal was applied to these reactors. At the engineering level if one were to take counterpart requirements for commercial reactors, one would find that because the production reactors are so different from commercial reactors that there is no possibility of taking the requirements as they are applied to commercial reactors and applying them to production reactors. It is just not the right yardstick to use. There was a lot of confusion at an engineering level as to how one would, in fact, achieve comparability, and we find that confusion in the way DOE approaches the problem.

An alternative would be to say that they should have an equivalent level of risk. But that poses all sorts of problems and that is a hard thing to calculate. And it is a bottom number in which there is a very large error bounds. So, it's a very difficult concept to apply.

Senator MCCLURE. It's difficult concept, but it is one that the public can understand. And therefore, the public responds when indeed that subject is raised.

Let me ask you a general question. In spite of the difficult you have in making a comparison, in your opinion should DOE be operating its reactors to the same level of safety as commercial reactors are required?

Mr. MESERVE. I have to give you a theoretical answer to that, and I can't give you a practical answer. We didn't look at how the safety in fact does compare.

But it would seem to me that the balance that one has to strike is one between the risks associated with operating and the benefits associated with operating. The benefit from operating these reactors is the nuclear materials that are produced and the need for those nuclear materials, a matter which we did not examine. But the product of operation is different from that of commercial power plants, which of course is electricity.

And theoretically it would seem to me that one could theoretically justify a different level of risk because the benefit associated with operation was different. They would not necessarily, it seems to me, as a matter of public policy have to be equal.

There is this goal of comparability that the Department has expressed, and we don't say that is wrong. I want to be careful to acknowledge that, but viewed simply as a logical matter, it wouldn't necessarily follow that comparability is inevitably where you have to be.

Senator McCLURE. Do you have any idea whether inspection and repair techniques could be developed that would enable DOE to adequately identify and resolve the potential aging problems?

Mr. MESERVE. You ask really two questions there. One has to do with inspection, and they do have aggressive inspection programs in order to be able to monitor the situation at those reactors. It is my understanding and really the point of our discussion of aging is that at this point at least it doesn't seem that there are feasible repair techniques. As a natural consequence of aging, you are going to reach a situation where once the problem arises you have the dilemma of either operating under circumstances that you can't fix and where there is an increased safety concern or foregoing the materials that these reactors produce.

Senator McCLURE. One of the difficult things for any discussion is to—let me rephrase that—to express in terms that are understandable and non-technical language the technical problems that are confronted.

Can you explain to us in layman's terms the design and configuration of the emergency core cooling system used at the Savannah River reactors?

Mr. MESERVE. Let me turn to one of my colleagues who is really more of an expert in that area. I could, but I think for the sake of accuracy, we'll hear from one of them.

Dr. DENNING. Well, I think simply it is a system of pumped water that if there were an accident that would lead to the leakage of collant from the system, it is important or imperative to provide water to cool the core, that there is a pumped water supply that pumps water into the system and keeps the fuel cool. It's really that simple.

Senator McCLURE. Is that system in that design an adequate system?

Dr. DENNING. We raised some issues in an earlier letter that had to do with some uncertainties about the ability of that system under that design-basis accident condition that led to a reduction to 50 percent power. I don't think that the members of the committee had any significant uncertainties about the adequacy of that system at the 50 percent power. That's probably all I have to say.

Senator McCLURE. How does it compare to state of the art systems in other plants, commercial plants, for example?

Dr. DENNING. It's very similar.

Senator McCLURE. Fairly similar?

Dr. DENNING. Yes.

Senator McCLURE. If it is fairly similar, why did you suggest that it needs to be reduced to 50 percent operating power?

Dr. DENNING. I thought that you meant in concept is it similar. In concept it is similar. There are differences that arise, particularly at Savannah River, that have to do with the down-flow through the core and the annular shape of the fuel rods that led to this particular technical difficulty in reflooding.

Senator MCCLURE. Did you have something further, Mr. Meserve?

Mr. MESERVE. The distinction here was that we did not necessarily recommend that they make any changes to the emergency core cooling system. The recommendation has to do with the operating limit, the power levels at which they operate such that they could be assured that the emergency core cooling system would serve its function. And they reduced the power in order to do that. And it was an analysis that underlay that determination.

Senator MCCLURE. If I understand it correctly, what you are telling us is that you are satisfied that it is adequate for the job at 50 percent power levels. And you have not I think run the analyses as to what power level above 50 percent it could be run at with adequate assurances of safety.

Mr. MESERVE. We, in fact, have not ourselves done the evaluation at any power levels. Our principal concern at the higher power levels has been ameliorated as we understand where the calculation was performed at the 50 percent power level. We have a recommendation that there be a thorough understanding of this system and how it would function before there would be a restoration in power levels. But really the underlying analyses here, ones on which we rely, are the ones that really the Department and the contractor performed. They are very sophisticated analyses.

Senator MCCLURE. Let me ask this question because I want to make certain I understand correctly. You are not suggesting that it is unsafe to operate above 50 percent power levels. You just have not seen the work that confirms at what level it can be operated above that level.

Mr. MESERVE. That's correct.

Senator MCCLURE. And it is your suggestion that it not be operated above that level until those codes have been established, until the assessments have been made.

Mr. MESERVE. That's correct.

Senator MCCLURE. You are not prepared at this time to indicate then whether or not changes to the core cooling system are required.

Mr. MESERVE. That's correct. There is a change that the contractor was making at the Savannah River plant, however, an engineering change. But we are making no recommendations other than that they validate the effectiveness of the emergency core cooling system at higher power levels before they move to higher power levels.

Senator MCCLURE. I am going to state a conclusion which is mine, and then ask if it is the same as yours. It is obvious from my reading of your report that the institutional systems at DOE are inadequate. Your recommendations fall short of totally independent safety oversight. I tend to agree with you that some middle ground can be found between today's situation where the lines of authority between DOE field offices, the operating contractor, DOE

headquarters and the safety division are poorly defined and confusing at best and a totally separate agency.

Could you explain your proposal for the oversight function?

Mr. MESERVE. Let me comment on the preface of that question, if I may, Senator.

Senator MCCLURE. Surely.

Mr. MESERVE. I think it is important to recognize in connection with the Department's performance that although we have many areas where we think that its efforts need to be improved and strengthened, that over the last year and a half or so that they have made advances. And that was important to us in determining what was an appropriate step on which to build. And we see that there have been significant advances made by the Department before Chernobyl to deal with this problem, and certainly major advances after Chernobyl. So, we thought there was a foundation on which to strengthen and prove the oversight function to assure the safe operation.

It was our view that an outside oversight body that would be advisory to the Department would be helpful. It would be helpful in a couple of ways, and I mention two. One is that we have recommended that there be some people involved in that activity who are outside the DOE community. And that is important because, first of all, there was a lot of experience that has grown up over the years with commercial reactors that we think could be more effectively applied than it has been to date in connection with the production reactors. And I think having some people with that experience from the commercial reactor community could be enlightening to the Department, and giving them an oversight role would be very helpful to the Department in achieving its role.

And then second, it was our view that having an oversight committe that was operating in the public—reports and recommendations in the public—a committee that was of people with recognized stature in safety issues would be very important in restoring public confidence that the system was actually, in fact, operating effectively and properly.

Senator MCCLURE. Have you looked at the oversight provisions established in S. 748 as reported by this committee? That's the Price-Anderson bill.

Mr. MESERVE. We have seen them. I am not prepared to comment on them in detail.

Senator MCCLURE. Anybody else on the panel that is?

[No response.]

Senator MCCLURE. Have you considered Senator Glenn's approach in S. 1085?

Mr. MESERVE. I'm sorry, Senator. We are really not in a position from having reviewed the matter to comment on any of the pending legislation. We have a recommendation that obviously bears on it, but we achieve that recommendation really independently of activities here on the Hill.

Senator MCCLURE. Have you seen DOE's press release today of steps they are taking with respect to independent oversight?

Mr. MESERVE. At about noon today we received a copy of the press release. And I have only scanned it, but we have seen it.

Senator MCCLURE. From your scanning does it look like it is satisfying the objectives or moving in the direction of your objectives? Or can you characterize it?

Mr. MESERVE. Well, we have a report which is, as you can see, a substantial volume. it seemed to me that the main theme was one of endorsement by the Department of our activities. I think that we would really want to see—and I'm sure that you would want to see far more detail as to what precisely the Department proposes to do in order to assess the effectiveness of their action. But certainly the tone of their press release seems to me to be one that we are very encouraged by.

Senator MCCLURE. Would it be fair for me to submit a question to you for response in writing and give you the opportunity to look at it a little more and then perhaps be able to respond more specifically?

Mr. MESERVE. That would be fair, Senator. I would point out that the press release is a very abbreviated statement. And it would be hard to comment on that because we have so much material here, and it would be impossible for them to be in a position within just a day or two of having seen the report to react to all of it.

Senator MCCLURE. What I am really after is not whether they have responded to your report, but whether the actions that they have taken, the actions themselves accomplish what it is you have suggested. I think that——

Mr. MESERVE. They are certainly moving in the right direction.

Senator MCCLURE. I'm sure of that, and I commend them for that. I want to know how far they have moved in that direction and whether they got there. I would be pleased if they got even further. I would expect you would be pleased if they had done everything you had suggested and more. That is what I am really after is from the analysis that you have made and the study that your panel has undertaken to evaluate whether or not what they are proposing to do is sufficient.

Mr. MESERVE. Senator, we would obviously be happy to accommodate you in whatever way we could.

Let me state, however, that we are a committee of volunteers. And we have put a lot of work——

Senator MCCLURE. Excellent volunteers.

Mr. MESERVE. We have put a lot of effort into the preparation of our report. And one of the recommendations that we have provided would be that there be established an outside oversight board. It is my understanding from a quick skim of the press release that the Secretary intends to establish such a board. I would think that our report, the Department's reaction to it, the comments that are made by others having to do with the N reactor might be appropriate early documents that that oversight board would want to familiarize itself with and satisfy themselves that the Department has addressed it appropriately.

We have the problem of several other large reactors that the Department has asked us to review. And it is our intention, having looked at the production reactors, to move on to those others.

Senator MCCLURE. You have been particularly cirtical of DOE management of Savannah River, especially concerning DOE's level

of involvement in plant operation and safety. In your opinion what specific corrective actions must be taken?

Mr. MESERVE. Well, we have some recommendations in chapter 3 having to do with the strengthening of the management system. We have recommended in particular that the ES&H organization, which has made great strides over the last year and a half, be strengthened. That would involve both personnel and in their technical capability.

We have an important recommendation that perhaps I ought to highlight about the significance of their having a significant on-site presence, which is something that they lack today. The NRC has inspectors who are present at commercial power plants and have authority there. ES&H in some sense plays a similar role in connection with the production reactors. And I think that a somewhat greater activity by them to build on the progress they have made would be appropriate.

Senator MCCLURE. How adequate is Savannah River's existing heavy water reactor design in terms of today's safety standards? From an engineering and design perspective, how much effort and time would it take to bring this design up to today's safety standards if we were to choose this technology for a replacement production reactor?

Mr. MESERVE. I'm hesitating in answering because the problem your question presents to me is your use of today's safety standards in that the NRC standards, as we understand them, are ones that have been developed for a different type of ractor, and their direct applications to the Savannah River is something that would be inappropriate so that there is an undefined term in your question.

Senator MCCLURE. All right.

Mr. MESERVE. Perhaps Dr. Kastenberg has some light he would like to shed on that question.

Dr. KASTENBERG. If I understood the question correctly, the thrust is whether or not one could build a new Savannah River type reactor and have it comparable to safety standards that we have today.

Senator MCCLURE. Yes.

Dr. KASTENBERG. Well, again, first the committee did not really look at that question. The committee's concern was that whatever analysis that you would need for today's reactors as they exist. If you went to build another Savannah River, you would have to do that for the new reactors. And we felt in the course of the study that there was nothing that was insurmountable. I mean, these are things that are doable given the resources.

Senator MCCLURE. Let me ask this question this way. Is there any difference between going through that analysis and design to respond to the analyses from that of coming with a nearly totally new design for a different kind of technology?

Dr. KASTENBERG. That is something we didn't address.

Senator MCCLURE. Is the methodology different?

Mr. MESERVE. I think it would depend on the type of design for one thing. But certainly on fundamental levels, you would do a similar type of analysis for I think any design. The details might be different dependent on the approach you take.

Senator MCCLURE. Whether it is a redesign of an existing technology in an existing plant or the design of a new one which is in development.

Mr. MESERVE. You would do a similar type of analysis.

Senator MCCLURE. It is a similar kind of analysis with approximately the same degree of complexity of analyses, same time lines that are involved in assuring design compatibility with current standards.

Mr. MESERVE. That's correct.

Dr. POWERS. I was just going to comment that the difficulty in a new design is just getting a fixed design to do the analysis. Otherwise, it is very similar.

Senator MCCLURE. Do you know if severe accident analyses and probability risk assessments have been done for a new heavy water reactor design?

Mr. MESERVE. I am not aware of one. No, we're not aware of any.

Senator MCCLURE. If not, how long would it take to do those analyses?

Mr. MESERVE. It is a substantial task. I think the time scale is on the order of years. Rich, do you have a——

Dr. DENNING. Yes. I might make a comment. There are different uses of probabilistic risk assessment, and the probabilistic risk assessment you do at the design stage. And we haven't really done that in the past, but it is clearly something one would now do with today's technology. It is different from the probabilistic risk assessment you do after the design is completed. And so, I think that you could look at the probabilistic risk assessment at design stages being a natural part of the design process that probably would not add substantially to the design process.

Senator MCCLURE. But as a part of the design process—let me put it this way. It is a necessary part of the design process today.

Dr. DENNING. I certainly believe so.

Senator MCCLURE. You wouldn't accept the notion that you go through design without doing that.

Dr. DENNING. I wouldn't, although in reality it hasn't been done in the past.

Senator MCCLURE. I understand. And we haven't even done it with respect to the operations which is I understand one of the criticisms you have and one of the suggestions you have.

And I want to stress the fact that I believe what you are telling me and what you are telling this committee is that, indeed, you found some deficiencies in the operations of Savannah River which need to be addressed and which you believe are being addressed in the main. And we should insist on following through to see that they are addressed. Is that correct?

Mr. MESERVE. That's correct.

Senator MCCLURE. It is not a study that focuses on deficiencies, and say, oh my God, close it down——

Mr. MESERVE. Certainly we're not saying that.

Senator MCCLURE [continuing]. As some would have us believe you might have said. But it is one that says here are things that need to be done, and let's get about doing them.

Mr. MESERVE. That's correct.

Senator MCCLURE. All right.

Senator EVANS. Mr. Chairman, I wonder if I can interrupt at that point.

Isn't that essentially the same approach at Hanford as well as Savannah River?

Mr. MESERVE. Yes, that's correct.

Senator MCCLURE. Is there an existing infrastructure—that is, vendors, suppliers and engineers—that supports the heavy water reactor technology that can help DOE resolve the concerns expressed in your report?

Mr. MESERVE. We don't think that any of the recommendations that we have made are such Herculean tasks that the Department would throw up its hands upon getting our report and just conclude that it can't be done. This is not path-breaking work that we are calling upon them to do. It is something which there is experience with commercial reactors, and that information and knowledge obviously will have to be adapted and changed to reflect the different designs of these reactors. But there is a knowledge base about how to undertake the work that DOE could rely upon.

Senator MCCLURE. Let me rephrase the question a slightly different way.

As you know, there are a number of people that were out pushing their own concept of designs for a new production reactor. There are various vendors who have a stake in that. Nobody is building any plants right now. So, you don't have a team that is out there ready to do this work in the sense that they are already involved in it, they are part way done with it. They can simply put a new cover page on an old piece of work and hand it in and say that's done. Isn't that correct? That's true of any design.

Mr. MESERVE. That's correct I think in essence that there are people available.

Senator MCCLURE. We are talking about a community of technically qualified experts: engineers, physicists, chemists, safety experts, the whole realm of disciplines that apply to a plant of this complexity. And those technicians have technical expertise that can be applied to whatever task you assign them. But they are not already tasked to a specific assignment.

Mr. MESERVE. I'm really not in a position to really be able to judge the manpower supply situation. And quite frankly, I will tell you—in the difficulties we have in assembling my committee from time to time, I can tell you that people who do this work are busy, at least the good ones. But it is not——

Senator MCCLURE. There aren't any bad ones. [Laughter.]

Mr. MESERVE. But it is not my understanding that this is a task that is going to be limited in its capability of being performed by the inadequacy of people.

Senator MCCLURE. It is not going to be constrained because they don't exist, but it isn't going to be expedited in one direction or anothrr because that team is already there doing the work.

Mr. MESERVE. Well, I think it is fair to say that at both the plants there are teams that are doing—there are contractors who are engaged in doing work along the lines of some of the things that we have recommended. It is under way.

Senator MCCLURE. Do they lead you in any direction—from your assessment of the work that is being done to the extent that you

have done it, does that lead you in any direction of saying going this way is going to be easier or quicker than going that way?

Mr. MESERVE. Do you mean in terms of addressing our recommendations in the report?

Senator MCCLURE. In terms of addressing which technology choice should be made for a replacement production reactor.

Mr. MESERVE. We really didn't have an opportunity to address that issue. All the issues associated with the new production reactor or an alternative to that reactor was something that was just beyond our charge, and we did not examine it.

Senator MCCLURE. I have a number of another questions which will be submitted for a response in writing. And I am very mindful of the fact that each of you gentlemen have full-time occupations. And that necessarily means you are doing this in addition to what you do otherwise. I think the Nation should note that and be grateful for the fact that people with the National Academy of Sciences are willing to undertake tasks that are assigned to them from time to time and give us the kind of work that has been given in this instance and is done many, many other times in other ways. I think far too many people assume it is done easily with not sacrifice and no effort, and they review a report that comes out and say, well, isn't that nice that those fellows did a job without really stopping to think what was entailed in getting that job done. I for one want to highlight that and to say thank you to the National Academy of Sciences and to you individually for the work that has been done that is very, very helpful as we try to resolve problems of this kind.

All members of the commmittee may have until close of business tomorrow to submit questions in writing for submission to the panel for their response in writing. And of course, we would appreciate your response as rapidly as is possible for you to do.

Senator EVANS.

Mr. MESERVE. Thank you, Senator.

Senator EVANS. Mr. Chairman, I just have one clarification question and then a final comment.

I am not sure I heard correctly, but we were talking about the process tubes at Hanford and the potential problems connected with them in terms of cracks and that sort of thing and the potential desirability of a complete examination of all tubes over a period of time. I don't know whether I heard any one of you say that cracks per se had been discovered at this point in the tubes. And the report uses somewhat different words, which it says, "Recently indications of surface and subsurface flaws in N reactor process tubes have been found using eddy current and ultrasonic techniques." That has resulted in extended the number of non-destructive examination to 152, and then the decision by the agency to destructively test 6 tubes.

Would you care to clarify just so we know precisely what we are talking about?

Dr. POWERS. Out of 150 tubes that they have examined, they have discovered flaws, which you might call cracks or at least initiators for cracks—39 of them in 21 tubes. So, there have been cracks or flaws detected that would cause pause as far as the integrity of the tube. The question is whether those cracks will propa-

gate to the point that they cause a loss of integrity in the tubes in the calculation of that—how long it takes for that crack to propagate to a point that it represents a failure of the tube.

Senator EVANS. I wonder if we could be a little more specific because I think we may be getting into a point where there could be some misunderstanding by the public. The public—when you say a crack is a crack, they understand what a crack is. It's something that something flows through. And it seems to me isn't it more accurate—I have the report of the destructive tests which indicated that—it said, "Because non-destructive examination by eddy current and ultrasonic testing method had identified flaw indications which could not be unequivocally characterized and sized. These indications were of concern because they occurred in conjunction with abraded depressions or fret marks associated with the flow-induced vibration of space or elements used to center the fuel column in the pressure tube."

And then they go on to say that as a result of their destructive tests where they go in, and they say, "No cracks have been found in any of these sections."

Dr. POWERS. Let me be very careful. The flaws we speak of in the report are flaws in the tube that do not penetrate completely through the wall. So, there would be no flaw flow through those flaws.

Senator EVANS. Right.

Dr. POWERS. In addition, one has to understand that even if there were a crack that passes all the way through the wall, the question is would it continue to propagate to cause a major loss of coolant that the plant could not tolerate. These plants are, in fact, shown by the contractor to be safe to the rupture of a single tube.

Senator EVANS. Would it also be accurate to say that while ultrasonic and similar testing, non-destructive tests, are indicative and they are very helpful, they are also not precise or not as precise as actually cutting through and examining and seeing just what you have? It may indicate a flaw, but flaws can be of a variety of types.

Dr. POWERS. What you say is absolutely true. We call attention to the fact that the contractor is carrying out a destructive test in order to calibrate his non-destructive methods, that at this point in time he becomes concerned if his non-destructive techniques indicate a very deep flaw because his non-destructive techniques lose sensitivity at a certain depth of flaw.

Senator EVANS. Does it help in that process by having destructive tests and then comparing them back with the non-destructive test made on the same piece of pipe you get some correlations that eventually will give a clearer indication of what you are seeing with a non-destructive test?

Dr. POWERS. The contractor is clearly attempting to do that right now.

Senator EVANS. Is that a reasonable series of events?

Dr. POWERS. It is a scientifically accepted metallurgical practice to try to do that to the best of your ability. He has a limited data base right now, and it is one of the reasons we said he should consider going beyond his limited examination, but think about the possibilities of either a statistically based examination of the tubes

or go to 100 percent examination because that correlation as yet is imperfect.

Senator McCLURE. Senator, could I break in for just one follow-up question——

Senator EVANS. Yes, certainly.

Senator McCLURE [continuing]. For an earlier question that I had asked and I neglected to follow up on it?

I had mentioned in my opening statement and again in direct questions that you found nothing in the Savannah River operation that convince you that it was unsafe for the operation above 50 percent power levels to which you responded in the affirmative. You had not. There was nothing there to indicate that it was unsafe or unreasonable at that level.

I think one of the original charges to the panel was that if you found more serious or immediate problems, you were to raise those with DOE promptly. Looking at your report, what it did not day, as well as what it did say, you did not make any report to them and, therefore, the inference is you did not find any such serious or immediate problems that justified such a report. Is that correct?

Mr. MESERVE. Well, actually the factual circumstances was one in which we did send such a letter, and that letter was one of the factors that the Secretary considered in reducing power to the 50 percent level. Our major concern that we had that resulted in our sending that letter was satisfied by that reduction in power.

Senator EVANS. That letter was sent subsequent to the initiation of your current study.

Mr. MESERVE. Yes, It was during the course of our study that we sent that letter.

Senator EVANS. YES. So, it was as a result of what you found in your initial examination that you recommended lowering from 75 to 50 percent the power level.

Mr. MESERVE. We didn't actually specify a power level.

Senator EVANS. I see.

Mr. MESERVE. We indicated that there was a problem, and the Department conducted an analysis that would justify a power level that would serve to alleviate the principal concern that resulted in our sending a letter.

Senator EVANS. I would just say, Mr. Chairman, that it is interesting. In talking about 100 percent examination of any or all parts of a device like this, we as politicians take polls of 1,500 people and expand them to the whole Nation and say that it is within an error factor of just 2 or 3 or 4 percent which is extraordinary confidence. Even that level of confidence we cannot accept in something of this nature where we have to be a lot closer to 100 percent certain.

Senator McCLURE. I would hope that they never follow our——

[Laughter.]

Senator EVANS. Let me just finally join with the Chairman in saying that we are extraordinarily gratified and appreciative of the work that you have done and hope that you will express that on our behalf—I know on the whole committee's behalf—to all of the members of the panel. It is a labor of love because there isn't much else connected with it. And we are grateful, and I'm sure that out of this will come a significantly better operation of our production reactors and some better policies that will enable us to deal with

something that is about as important as anything we deal with, and that is ultimately the national security of the country. Thank you very much.

Mr. MESERVE. Thank you very much.

Senator MCCLURE. Gentlemen, again, thank you very much.

That concludes our hearing for today. The committee will be adjourned.

[Whereupon, at 4:25 p.m., the hearing was adjourned.]

FOLLOW UP QUESTIONS FOR THE DEPARTMENT OF ENERGY
October 27, 1987

From Senator Johnston

Health and Safety Issues

Question 1a: The National Academy of Sciences report indicates that there may indeed be serious safety problems at our existing facilities. One of the report's findings is that there is potential for an accident resulting from an uncontrolled power excursion at the Savannah River reactors similar to that which occurred at Chernobyl.

-- In your view, what is the potential for such a Chernobyl-type accident?

Answer: A Chernobyl-type accident cannot occur because of differences in design in the Savannah River reactors. The design of the Chernobyl reactor is such that it provides a large, positive reactivity feedback, or response, to an increase in void fraction. It was this effect that made the reactor fundamentally unstable and was one of the major contributors to the Chernobyl accident. Once steam bubbles were formed in the coolant channels of the reactor, the interaction between higher power and more steam bubbles resulted in a further increase in power, leading to a violent excursion. Further, Chernobyl had only a single slow acting scram system for use in shutting down the reactor in response to an accident. In contrast, the Savannah River reactors are designed with: (1) negative reactivity coefficients so that such an excursion cannot occur during normal operation; i.e., a power increase tends to be self-limiting rather than self-propagating; and (2) fast acting primary and backup scram systems.

Committee Note.--Classified responses are not printed in the Appendix.

Only if a severe accident first occurs is an uncontrolled power excursion then possible. On page 38 of the report, the NAS states, "One severe-accident scenario that requires prompt evaluation relates to the possibility of a runaway power excursion like that at Chernobyl." The report explained that this might occur if particles released from molten fuel (which could only become molten after an accident occurred) were carried upward into the moderator space in the reactor tank after being swept from the degraded core to produce a positive reactivity effect. The only way such a power excursion could occur would be the occurrence of multiple events, each with a very low probability of occurrence, e.g., complete flow blockage in a fuel assembly by some unknown mechanism coupled with the simultaneous failure of both independent shutdown mechanisms. Either of the reactor's two shutdown mechanisms would overcome the positive reactivity and shutdown the nuclear reaction. The probability that each reactor shutdown system will not work in conjunction with complete flow blockage is extremely remote.

FOLLOW UP QUESTIONS FOR THE DEPARTMENT OF ENERGY

Question 1b: -- Has DOE evaluated the potential result of an uncontrolled power excursion at these reactors?

Answer: Analyses conducted thus far do not indicate "an uncontrolled power excursion" is a credible scenario, per se, due to the physics of such an event, e.g., negative reactivity coefficient. Since the probability for an "uncontrolled power excursion" which would lead to severe core damage is so remote, it does not seem feasible that such an event could pose undue risk. However, a comprehensive probabilistic risk assessment (PRA) program is underway at Savannah River which will provide, within 2 years, confirmatory evaluations of risk.

Further, Savannah River is committed to a Severe Accident Analysis Program (SAAP) that will complement the PRA activity and provide an improved technical basis for future design and operational changes.

FOLLOW UP QUESTIONS FOR THE DEPARTMENT OF ENERGY

Question 1c: -- Does DOE believe that backup safety systems are adequate to mitigate such a severe accident?

Answer: As noted above, this scenario could only occur after an accident, in itself unlikely, had already occurred. Therefore, the probability of such an event is estimated to be very low. Nevertheless, based on the PRA results noted in the answer to question 1b., modifications to the reactor shutdown systems will be analyzed if the sequences involving failure of the scram systems are risk dominant.

FOLLOW UP QUESTIONS FOR THE DEPARTMENT OF ENERGY

Question 2a: Another concern raised by the NAS report is that there are significant uncertainties about the adequacy of the confinement system at both the N Reactor and the Savannah River reactors.

-- What is the potential that the confinement system at these reactors would overload and rupture during a severe accident?

Answer: At N Reactor, the confinement system would provide effective protection against fission product release from the plant under a wide range of accident conditions. Special confinement leak tests before and after pressurization of the confinement to design basis pressure were conducted and showed the capability to withstand such pressurization with low leakage before and after pressurization. As a result, a catastrophic rupture for a plausible range of severe accidents would not occur. Consideration of severe accident cases beyond those previously analyzed in detail will be documented in the PRA for the N Reactor.

Furthermore, the ability of the N Reactor confinement filtration system to mitigate radionuclide releases throughout a severe accident is being reevaluated. This reevaluation is addressing: (1) severe radionuclide and nonradioactive particulate source terms, and (2) potential filter failure due to overloading from radionuclides, nonradioactive particulates, debris, or unacceptable heat loads from collected radionuclides. Engineering analyses will provide bounds regarding the filter system effectiveness and filter system mass loading limits. In so doing, the margin of safety will be

assessed in order to determine whether the more detailed confirmatory analyses related to this issue can be conducted after resuming N Reactor operation. These bounding safety-related analyses will be completed by March 1988.

The Severe Accident Assessment Program (SAAP) has been initiated within the Savannah River Laboratory to better determine the conditions that the confinement system will experience during different severe accident scenarios. These conditions will include filter aerosol loadings, pressure pulses, and updated source term data.

Confinement heat loads were originally calculated based upon an assumed core melt fraction release. The fission product sources giving rise to these loads were similar to those assumed for earlier power reactor safety analyses. Recently, samples of irradiated fuel from SRP reactors were melted under simulated accident conditions. The tests yielded quantitative release data of noble gases, iodine, cesium, and tellurium.

These results have been modeled to characterize fission product release from hypothetical core melts. Based on the most recent fission product release data, it was decided in the fall of 1986 to procedurally actuate the reactor room spray system in the event of a severe accident. Basic data have been developed in support of a proposed reactor room spray system to improve the current reactor confinement system. Experimental studies

have been made on the effectiveness of the proposed spray system for removing volatile and particulate fission products from the reactor room air. Depending on airflows, up to 95 percent of iodine can be washed from the reactor room air by the proposed system. Measurements made of cesium aerosol removal under conditions similar to those that would occur in the reactor room indicate that most of the cesium aerosols ≥ 1 micrometer in size were washed from the air. Thus, the proposed system will greatly reduce the potential loading on the existing confinement system filters.

The performance of the existing and improved confinement systems has now been analyzed over a range of accident severity. Upper bound assessments were completed and have shown that the proposed spray system will function effectively for even the worst case rapid 100 percent core melt. Analyses have also shown that the existing reactor spray system will greatly mitigate the effects of a severe accident and will maintain the integrity of the existing confinement system. The proposed spray system will improve the reliability and capacity of the confinement sprays and will afford automatic system actuation. The existing system must be manually activated.

FOLLOW UP QUESTIONS FOR THE DEPARTMENT OF ENERGY

Question 2b: -- Could you please explain why, in your view, a confinement system provides as much safety as the steel and concrete containment system that exists at commercial facilities in the U.S.

Answer: As noted in the NAS report, the committee concluded that "in theory the confinement approach can be an acceptable means for mitigating accidents." In both designs, the objective is to provide substantial protection for the public and operating staff against severe accidents by delaying and reducing the release of radionuclides. Therefore, assuming proper design and construction (which are addressed in the NAS findings), the issue is the projected effectiveness of each design under a broad range of accident scenarios. Certain containment systems for commercial facilities have been analyzed from the standpoint of ability to withstand a similarly broad range of accident scenarios and have been found to be very sensitive. In this regard, the question of safety reflects both the likelihood of core damage and attendant containment failure. Safety is not provided solely by either a containment or confinement structure. Recent analysis has shown the vulnerability of selected conventional containment designs to overpressurization, which the confinement designs do not share. As a result, vented containments have come into use in European nuclear power plants and under consideration from the conceptual standpoint in this country. Risk studies are underway for these commercial facilities to better understand the risks associated with containment venting. Accordingly, a more pertinent comparison may be a confinement versus a vented containment, considering also the likelihood of core melt.

FOLLOW UP QUESTIONS FOR THE DEPARTMENT OF ENERGY

Question 4: Please elaborate on DOE's planned response to the NAS report.

Answer: DOE is responding aggressively to all the NAS recommendations, a process begun at the time of the report's issuance. Secretary Herrington is establishing an external oversight committee for nuclear safety under the Federal Advisory Committee Act. This committee will be made up of members with recognized stature and expertise reflecting experience in commercial facilities, prior DOE studies, and the NAS effort. The committee will be provided necessary funding and staff to perform its duties and fulfill its responsibilities.

Under Secretary Salgado directed the Assistant Secretary for Defense Programs to prepare an action plan to address and resolve each of the NAS recommendations on technical issues concerning N Reactor at Hanford and the production reactors at Savannah River. This plan will be reviewed independently by ES&H. DOE and its contractors will address all significant issues raised by the NAS such as reactor aging, power operating limits, probabilistic risk assessments, severe accident evaluations, confinement systems, hydrogen generation and mitigation, human performance, liquid effluents, and emergency planning.

Under Secretary Salgado directed the Assistant Secretary for Environment, Safety and Health (ES&H) to develop a plan to improve the Department's internal independent safety oversight

function, consistent with NAS recommendations regarding the DOE safety framework and strengthening the technical base of reactor safety management. The completed ES&H plan has been forwarded to the Under Secretary for his review and consideration. The ES&H plans are being reviewed for application on a broader departmental basis. The ES&H plan includes: strengthening DOE's ES&H organization, including an independent ES&H presence at the reactors; improving the appraisal and review process to provide more comprehensive appraisals and reviews of all facets of reactor safety; strengthening ES&H authority over safety compliance; and enhancing ES&H oversight resources both at the headquarters and field office level.

Also, in addressing the NAS recommendations regarding improving the DOE safety framework and strengthening the technical base of reactor safety management, other actions were taken. Under Secretary Salgado directed the Assistant Secretary for ES&H, along with the Assistant Secretary for Management and Administration, to clarify the safety objectives for operation of the production reactors, and also to develop a plan of action for revising the DOE order system and revising the orders to more clearly and explicitly specify the DOE safety requirements. The ES&H plan has been completed and forwarded to the Under Secretary.

FOLLOW UP QUESTIONS FOR THE DEPARTMENT OF ENERGY

Question 5a: The Department has indicated that it will respond to the NAS recommendation on independent oversight by establishing an external advisory committee reporting to the Secretary.

-- Will such a body have sufficient independence to do the job?

Answer: The external advisory committee will be independent and made up of members with recognized stature and expertise covering the full range of disciplines relevant to reactor safety. It will be provided with the necessary funding and independent staff to perform its job.

Question 5b: -- For the longer term, what type oversight function does the Department believe would be most appropriate.

Answer: As noted recently by the Under Secretary in testimony before the House Subcommittee on Energy and Power, the Department believes the newly established Advisory Committee for Nuclear Facility Safety should be given an opportunity to work before moving to a legislative oversight remedy.

FOLLOW UP QUESTIONS FOR THE DEPARTMENT OF ENERGY

Question 5c: -- Please comment on each proposal pending before Congress (S.748, S.1085, and House bills).

Answer: The Department's position on pending legislation on outside nuclear safety oversight was provided in testimony given by the Under Secretary to the Senate Armed Services Committee on October 27, 1987, and to the House Energy and Power Subcommittee on November 19, 1987. The prepared statements are attached.

FOLLOW UP QUESTIONS FOR THE DEPARTMENT OF ENERGY

From Senator Hatfield

Hanford N Reactor

Question 1: The Department's safety review and the Roddis panel of independent consultants provided some 228 safety and environmental recommendations for the reactor. Do you plan to implement these recommendations?

Answer: DOE plans to implement the 228 recommendations in the N Reactor Safety Enhancement Program even though the N Reactor has been placed in standdown condition indefinitely. Satisfactory completion will be verified by ES&H.

FOLLOW UP QUESTIONS FOR THE DEPARTMENT OF ENERGY

Question 7: If you begin operation of the N Reactor in December as planned, I understand that the planned EIS will not be complete and the planned safety improvements will be less than 50% complete (in dollar terms). Is that an accurate assessment?

Answer: N Reactor will remain in cold standdown condition indefinitely.

FOLLOW UP QUESTIONS FOR THE DEPARTMENT OF ENERGY

Question 8: In May 1986, shortly after the Chernobyl accident, the Secretary asked the National Academy of Sciences (NAS) to assess the safety of DOE defense reactors. As a result of your agreement with certain House members, as I understand it, the Department now agrees to carry out any recommendations made by NAS. Have you agreed to complete the recommendations before restarting operation of the reactor?

Answer: N Reactor will remain in cold standdown condition indefinitely.

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FOLLOW UP QUESTIONS FOR THE DEPARTMENT OF ENERGY

Questions from Senator Weicker

Question 4: To what extent in the Department of Energy's determination, must the NPR meet current safety and licensing requirements? To what extent do heavy water reactors of the current Savannah River design meet current safety and licensing requirements? Is there an existing industry infrastructure with the necessary experience for the design and supply of safe, licensable heavy-water reactors for NPR application?

Answer:

- The NPR will be designed and constructed to meet NRC safety standards.
- The Savannah River production reactors do not fully meet current NRC standards.
- It has not been determined that the NPR will be a heavy-water moderated design. If the NPR configuration represents a substantial departure from that deployed in LWR commercial power reactors, special criteria will have to be developed and applied.
- The Westinghouse Electric Company has been working, with internal company funding, on a heavy-water reactor preliminary design. It feels that a heavy-water reactor can be built that will meet or exceed current safety requirements.

FOLLOW UP QUESTIONS FOR THE DEPARTMENT OF ENERGY

Followup Questions from Senator McClure

Questions for Del Bunch

Question 1: What plans has DOE made to implement any or all of the changes that may be recommended by the National Academy of Science study?

Answer: DOE is responding aggressively to all the NAS recommendations, a process begun at the time of the report's issuance. Secretary Herrington is establishing an external oversight committee for nuclear safety under the Federal Advisory Committee Act. This committee will be made up of members with recognized stature and expertise covering the full range of DOE and contractor efforts. The committee will be provided necessary funding and staff to perform its duties and fulfill its responsibilities.

Under Secretary Salgado directed the Assistant Secretary for Defense Programs to prepare an action plan to address and resolve each of the NAS recommendations on technical issues concerning N Reactor at Hanford and the production reactors at Savannah River. This plan has been completed and is being reviewed independently by ES&H. DOE and its contractors will address all significant issues raised by the NAS such as reactor aging, power operating limits, probabilistic risk assessments, severe accident evaluations, confinement systems, hydrogen generation and mitigation, human performance, liquid

effluents, and emergency planning. All of these issues involve safety; therefore, ES&H will aggressively oversee the efforts expended to address these technical issues.

Under Secretary Salgado directed the Assistant Secretary for Environment, Safety and Health (ES&H) to develop a plan to improve the Department's internal independent safety oversight function, consistent with NAS recommendations regarding the DOE safety framework and strengthening the technical base of reactor safety management. The plan has been completed. The plan will include: strengthening DOE's ES&H organization, including an independent ES&H presence at the reactors; improving the appraisal and review process to provide more comprehensive appraisals and reviews of all facets of reactor safety; strengthening ES&H authority over safety compliance; and enhancing ES&H oversight resources both at the headquarters and field office level.

Also, in addressing the NAS recommendations regarding improving the DOE safety framework and strengthening the technical base of reactor safety management, other actions were taken. Under Secretary Salgado directed the Assistant Secretary for ES&H, along with the Assistant Secretary for Management and Administration, to clarify the safety objectives for operation of the production reactors, and also to develop a plan of action for revising the DOE order system and revising the orders to more clearly and explicitly specify the DOE safety requirements. The plan has been completed.

FOLLOW UP QUESTIONS FOR THE DEPARTMENT OF ENERGY

Question 2: Have severe accident analyses and probability risk assessments been done for a new heavy water reactor design? If not, how long would it take to do these analyses?

Answer: No. The complete PRA of the Savannah River production reactors is scheduled for completion in March 1989, a four and one-half year effort. A similar PRA for a NPR would probably take at least 2 years to complete but be available only after a final design is available.

FOLLOW UP QUESTIONS FOR THE DEPARTMENT OF ENERGY

Question 7: We know about neutron embrittlement and stress corrosion commercial plant experience. Similar phenomena have been observed in the Savannah River reactors, and indeed the inability to repair such a crack has permanently closed the C Reactor. Even though no such cracks have been discovered in the other Savannah River plants, isn't it true that the major method used by the contractor for crack detection is visual inspection and does not include ultrasonic testing? If visual inspection adequate? Can all areas susceptible to cracking be thoroughly inspected by this method? Would ultrasonic testing provide more conclusive evidence?

The inability to repair the C Reactor would seem to indicate that there is not existing technology to repair any crack that would develop at these aging reactors.

Answer: The primary methods used for crack detection are visual and liquid penetrant (PT). Ultrasonic testing (UT) has been shown in commercial plants to be rather poor at detecting stress corrosion cracking. Visual inspections found almost all the cracks in the C tank before any UT was performed. Indeed, the material and water chemistry conditions in the Savannah River reactors have created a very sensitive mechanism for visual crack detection. Most areas of the tanks can be inspected by visual and PT. Existing UT technology appears to offer limited extension to visual or PT crack detection capability.

From the evidence we have available, it appears that repair by welding, the normal repair technique for steel tanks and pipes, on materials previously subjected to significant neutron

radiation may be impossible. Thus cracking in the P, K, or L tanks in high fluence areas could lead to shutdown. It should be noted that the cracking in C Reactor occurred in a furnace-sensitized part of the tank that is unique to that reactor; none of the other reactor tanks contain material having a similar fabrication history.

FOLLOW UP QUESTIONS FOR THE DEPARTMENT OF ENERGY

Question 8: The Assistant Secretary for Environment, Health and Safety was recently given authority to shutdown any facilities for safety violations or hazards. Does this authority apply to the production reactors?

Answer: Yes.

FOLLOW UP QUESTIONS FOR THE DEPARTMENT OF ENERGY

From Senator McClure

Questions for Troy Wade

Question 2: Can you substantiate your assumptions about the safety of the production reactors by any standard methods such as those required by the NRC? (By that, I mean severe accident analysis codes, probabilistic risk assessments and experimental verification data?)

Answer: DOE can, and is, substantiating the safety of the production reactors by standard methods such as those required by the NRC. For N Reactor and the Savannah River Production Reactors severe accident analyses and probabilistic risk assessments are being made. These analyses and assessments are similar to those performed for commercial power reactors, although the data base applicable to the production reactors is limited.

FOLLOW UP QUESTIONS FOR THE DEPARTMENT OF ENERGY

Question 3: In the face of the growing concerns in Congress and with the public, regarding the condition of the nation's production reactors, as well as the NAS finding, how will you demonstrate that continued operation of these reactors will not pose undue risks to the public health and safety?

Answer: Minimum safety standards are derived from the safety analysis review of the reactors and are reflected in the technical specifications by which acceptable operation is defined. In addition to assuring strict adherence to these standards via the Department's reactor safety appraisal programs, the application of systematic design and operational assessments programs, such as the Integrated Systematic Evaluation Program, incorporating results of probabilistic risk assessments (PRA's), and continuing Technical Safety Appraisals and inspections by the Headquarters Office of Environment, Safety and Health and field operations offices will provide assurance that continued operation of these nuclear facilities will not pose undue risks to the public health and safety.

FOLLOW UP QUESTIONS FOR THE DEPARTMENT OF ENERGY

Question 4: What kind of a commitment has DOE made to upgrade safety at Savannah River?

Answer: DOE is very committed to upgrade safety at Savannah River. A systematic evaluation program will be performed, similar to that conducted at older licensed reactors, to help assure that all necessary safety upgrades are identified and implemented.

The Department has initiated and completed numerous projects to enhance safety at SRP; including the Automatic Incident Action system, a full-scope simulator, the automatic backup shutdown system, safety computers, seismic protection, confinement heat removal, diagnosis of multiple alarms, and essential equipment monitors. These projects are examples of the Department's actions to ensure that reactor safety and overall accident prevention and mitigation have been continually evaluated and upgraded. Current upgrades include reactor electrical distribution system improvements, confinement spray system improvements, fire protection system improvements, and various support system improvements. The Department plans to continue an aggressive program of physical improvements to the reactors to enhance safety.

FOLLOW UP QUESTIONS FOR THE DEPARTMENT OF ENERGY

In addition to physical upgrades, extensive improvements in operations and in safety technology support have been made, are underway, or planned. Operator and maintenance training, quality assurance, operating and maintenance procedures, etc., have been significantly improved. A Severe Accident Assessment Program has been initiated and an extensive analytical and experimental program is underway to improve our understanding of the performance of the Emergency Cooling System (ECS) under a worst-case loss-of-coolant accident. Reactor power was reduced to less than 50 percent until a full understanding of the ECS capability is established.

Also, the Department has initiated an integrated safety evaluation program which will evaluate the Savannah River reactors and nuclear facilities against applicable current Nuclear Regulatory Commission criteria and requirements for power reactors. These activities will ensure the continued safe operation of the SRP. The Department is currently evaluating the National Academy of Sciences (NAS) Report and will modify its ongoing programs as necessary to address the NAS issues.

FOLLOW UP QUESTIONS FOR THE DEPARTMENT OF ENERGY

Question 5b: NAS cites weaknesses in the confinement systems at Savannah River and N Reactor. The public relies on this for protection. If a Savannah River plant were shutdown for an upgrade of the confinement system, wouldn't it be vulnerable to an EIS before it could be restarted?

Answer: An upgrade of the confinement system is an action that would be subject to NEPA review. The level of NEPA review and documentation would depend on the potential environmental impacts of the upgrade.

FOLLOW UP QUESTIONS FOR THE DEPARTMENT OF ENERGY

Question 10b: Will it be DOE's intent that the New Production Reactor meet current safety standards?

Answer: Yes, according to DOE Orders any new reactor must meet current safety standards. This has been DOE's requirement and practice in the past. For example, the Fast Flux Test Facility at Hanford met all safety standards current at the time of its design and construction. It went through a thorough NRC staff and ACRS licensing review, even though it was not licensed by the NRC.

FOLLOW UP QUESTIONS FOR THE DEPARTMENT OF ENERGY

Question 10d: What priority does DOE intend to give to inherent safety features in making a technology selection?

Answer: Safety of reactor operations is of great importance to DOE. Any reactor must have an acceptably safe design as determined by a rigorous safety analysis process before it can be constructed. Inherent safety features will factor in the technology selected for the New Production Reactor.

FOLLOW UP QUESTIONS FOR THE DEPARTMENT OF ENERGY

Question 13b: If DOE were required to do a complete EIS on restart of N Reactor, how long would this take?

Answer: DOE estimates that it would take 24 to 36 months to complete a broader EIS. Of course, this estimate is dependent upon definition of the exact scope of such an EIS.

Responses from Richard A. Meserve to
Questions from Senator Johnston

Question 1a.

Certain members of an earlier DOE-appointed panel that reported to the Secretary of Energy on the implications of the Chernobyl accident on the operations of the N-Reactor at Hanford recommended that the N-reactor be shut down and stay shut down.

What is the recommendation of the panel that developed this National Academy of Sciences report on the restart of the N-reactor?

Response

The committee did not address the restart of the N Reactor.

Question 1b.

If there is no recommendation on this matter, should we conclude that the panel would not be concerned if DOE restarted the N-reactor?

Response

The committee developed a large number of recommendations for improving the safety of both the N Reactor and the Savannah River reactors. We would hope that the Department will examine these recommendations in the context of assessing the operational readiness of the production reactors.

Question 1c.

Is it the understanding of the NAS panel that DOE is making a good faith effort to implement the N-reactor safety recommendations made by the earlier panel?

Response

DOE has implented a program to respond to the recommendations of the so-called Roddis panel. The committee did not attempt to assess the responsiveness of DOE to the recommendations.

Question 1d.

What did the NAS panel find with regard to the N-reactor restart process now under way at Hanford?

Response

As noted above, the committee did not address the question of restart.

Question 2.

One of your recommendations is that the Department make substantial efforts to develop a thoroughly documented understanding of how DOE reactors would behave under a loss-of-coolant accident.

Could it be inferred from this recommendation that the N-reactor should not be restarted until such an understanding has been reached, or that the Savannah River reactors should not be operated at all until such an understanding has been reached?

Why or why not?

Response

Any determination of whether the reactors are safe to operate involves a determination of acceptable risk. An examination of this issue, although important, was beyond the charge to the committee.

If the committee had become aware of an immediate safety issue that was not adequately appreciated by the Department, we would have informed the Department. Indeed, the power reduction in the Savannah River reactors was the result in part of exactly such a communication with the Secretary. The committee did not see a need to communicate immediately with the Secretary in connection with operation of the Savannah River reactors at the final reduced power levels.

Question 3a.

Your report finds that there are significant uncertainties about the ability of the existing confinement systems at DOE reactors to mitigate the consequences of accidents.

Which accidents?

Response

The committee's discussion of the production reactor confinements deals exclusively with accidents involving the melting of fuel and subsequent release of radionuclides to the confinement atmosphere.

Question 3b

What is the likelihood of these accidents?

Response

The likelihood of such accidents at the defense production reactors is at present indeterminate, although they are believed to be remote. The analysis of the likelihood of such accidents is the subject of ongoing probabilistic risk assessments of the reactors.

Question 3c.

Given these uncertainties, couldn't we conclude that the reactors should not be operated?

Response

Whether the reactors should or should not be operated depends upon what level of risk that the Executive Branch, the Congress, and ultimately the American people are willing to accept. The committee was not charged with defining acceptable risk. The committee did note that the lack of severe accident research at the production reactors would indicate that the Department should employ substantial safety margins in the design and analysis of safety systems at the reactors until severe accident research results are available.

Question 3d.

For example, should we be comforted by the fact that - as you say - the reactors are in relatively isolated locations?

Response

The population at risk from the production reactors is substantially fewer in number than that surrounding most commercial nuclear power plants.

Question 4.

One of the most common reactions to the Chernobyl accident in DOE and in the nuclear industry has been that the Soviet accident was certanly bad, but is couldn't happen here.

Your report seems to qualify that confident assertion.

Is that correct?

Please explain.

Response

As discussed in the report at pages 3-5, the production reactors do not have the design features that contributed to the Chernobyl accident. Hence, such an accident cannot happen in the U.S. The committee did address the possibility of a power excursion at Savannah River at pages 38-39. The probability that such an excursion could occur at Savannah River is likely to be highly remote, but we recommended that the risk be analyzed.

Question 5a.

What were the NAS panel recommendations with respect to safety oversight of DOE defense production activities?

Response

The committee recommended that DOE establish an independent, external oversight committee, advisory to the Secretary of Energy. This recommendation is discussed in detail at pages 65-67 of our report.

Questions 5b.

Could the Advisory Committee on Reactor Safetguards be used by DOE to oversee nuclear facilities? If the ACRS declines this role, what kind of credible permanent outside review mechanism should be established?

A policeman and investigator such as the Inspector General?

An independent advisory board within the Department?

The Nuclear Regulatory Commission?

Please discuss.

Response

Although the Secretary has the statutory authority to seek ACRS review of DOE reactors, the committee recommended that DOE have its own independent advisory committee. The committee's views on this issue are presented on pages 63-64 of the committee's report.

Question 6a.

Did the NAS panel examine the role of Departmental organization in safety at DOE defense production facilities?

For example, did the panel feel that the establishment of an Assistant Secretary for Environment, Safety and Health within the Department has significantly improved day-to-day practices in safety?

Response

The committee did address the Department's management structure at pages 63-64 of our report. The committee believes that DOE has made a number of important strides in strengthening safety oversight of the production reactors, including establishment of an Assistant Secretary for Environment, Safety and Health. The report recommends additional measures to bolster, institutionalize, and sustain these efforts.

Question 6b.

What are the effects of the DOE field offices on efforts to upgrade safety practices? Does the field-office style of management have advantages of flexibility, or does this organization tend to reinforce bureaucratic resistance to change?

Response

The committee did not examine either the "flexibility" or the extent of "bureaucratic resistance to change" at the field offices. The report does describe a marked imbalance between DOE and contractor staff, both in terms of the small number of safety staff at the local offices and their relative technical inexperience.

Question 7.

What are the NAS panel's views on the range of costs associated with establishing adequate safety at DOE defense production facilities?

What is your own personal view?

Won't adequate safety require new facilities very soon? How soon?

What would be the likely costs associated with a "muddling-through" policy that makes no commitment to new facilities?

Response

The committee did not analyze the economic costs of safety oversight, and I have no basis for setting out a personal view. The committee observed that the remaining lifetime of the four production reactors is likely to be equal to or shorter than the time needed to build new facilities to produce special nuclear materials. If the United States finds it necessary to have a reliable capability to produce these materials, planning for new sources should be accelerated. If action is not taken, the federal government will have to forego the material currently being produced, or operate the reactors under conditions in which safety is compromised. The committee does not recommend a "muddling-through" approach.

Responses from Richard A. Meserve to
Questions from Senator McClure

Question 1.

Can you say with a high degree of confidence that operation of the Savannah River reactors at 50% power is adequately conservative to protect public health and safety? What about in the event of a severe accident scenario, such as the one you identified where a flow blockage is followed by a power spike, and the control rods cannot respond in a timely manner? Could this happen? How likely is it? What would the consequences be?

Response

It would take a highly unlikely accident to produce conditions that would challenge the capability of the ECCS to cool the fuel. The committee did not review the computational basis for the current 50% power limits at Savannah River. DOE and the contractor believe the current reduced power limits would not result in boiling in the fuel assemblies during a loss-of-coolant accident and, if so, the committee's main concern with the former limits has been addressed.

The power excursion discussed by the committee in the report assumes full power operation, blockage of coolant flow, and failure of one or both of the scram systems. If such a scenario were to occur, there is a possibility of uncontrolled melting of fuel. The likelihood of such an accident is believed to be extremely remote, but the committee recommended in the report that analyses of the risk be completed.

Question 2.

How deficient is DOE in its knowledge and analyses of design-basis and severe accident conditions? Does DOE have any supporting evidence--such as probabilistic risk assessments and severe accident computer codes--to quantify the safety of its defense reactors? Can these analytical tools be developed with respect to these old reactors? How long would this take? Given the age of these reactors, is it worth the effort? Does DOE have the necessary resources to do this work?

Response

The committee examined the efforts to undertake probabilistic risk assessments ("PRAs") and evaluate severe accidents at pages 31-39 of our report. PRAs are currently underway at both sites and preliminary results have been obtained. The committee's report includes several suggestions for strengthening the PRA effort.

The existing level of analysis of severe accident behavior at the reactors is inadequate. Although the appropriate analytical tools and experimental validation could be completed in three to five years, there is a legitimate question as to whether, given the age of the reactors, such a program should now be undertaken. The committee therefore recommends that near-term decisions be guided by the results of simple models and by the application of large safety margins. If there is a significant probability that the lives of these reactors will be extended beyond the next several years, the committee recommends that the department commit to a significant program of severe accident model development and validation. Additional resources will have to be provided to accomplish this work.

Question 3.

Do you have any idea of the magnitude of retrofit and upgrading that might be required to bring these reactors within more acceptable safety limits?

Response

The committee did not describe the existing operations as "unacceptable"; it recommended ways to improve the safety of the reactors, including the development of an improved understanding of whether the safety systems will be able to respond effectively in an accident.

Question 4.

In your report, you state that much could be learned from completing Probabilistic Risk Assessments on the reactors, especially in terms of the engineering insight gained from this exercise. Can all of this "insight" be put towards practical applications? Can you give me some specific examples?

Response

It is generally found that involving plant operators in the conduct of PRAs leads to greater operator understanding of the reactor and its safety systems. Moreover, the discipline of conducting a PRA can reveal flaws in design or operating procedures. It is impossible to speculate as to where such flaws might exist at the production reactors. One might expect, however, that a PRA analysis could prove very helpful in examining the hydrogen mitigation system at N Reactor.

Question 5.

Explain to us why DOE's current plans to upgrade its confinement system at the Savannah River plants may be counterproductive in terms of overall safety enhancement?

Response

The committee is concerned that the improved confinement may be more vulnerable to failure during accidents. The improved confinement might allow the buildup of hydrogen gas, increasing the likelihood of a hydrogen combustion event.

Question 6.

How can we be assured that DOE will follow through on your recommendations? Will NAS play a role? Should NAS play a role?

Response

DOE has indicated publicly that it intends to respond to the committee's recommendations. The committee's report includes no recommendations as to a future role for the NAS with respect to the production reactors. We did recommend, however, that the Department create an independent oversight committee. That committee might appropriately examine the adequacy of the department's response to our report.

Question 7.

What kind of experimental data does DOE need to develop in order to verify its safety-related analytical data?

Response

The committee identified the need for more prototypic experiments as an underpinning for the analysis of potential severe accidents; it did not attempt to specify in great detail an appropriate experimental program. The types of analytical and experimental work that should be performed in the analyses of severe accidents is described at pages 34-38 of our report.

Question 8.

While your report addressed a lot of issues, there are a lot of areas that you did not touch upon. What would you recommend in terms of follow-up studies?

Response

The committee's report is of limited scope. Follow-up studies should be considered by the independent oversight committee that we urge the Department to establish.

Question 9.

I know that your report did not address technology options for replacement production reactors (RPR). But do you have any opinion on the technology choices available, especially in terms of safety and reliability?

a) Do you think an RPR should meet today's safety standards?

b) How important is redundancy of technologies? Redundancy of sites?

c) Should we be looking to inherent, passive safey features that could be incorporated into the next reactor?

d) Is there a safety benefit to construction of several smaller, modularized units?

Response

The committee did not address and has not formed an opinion on any of these matters.

Question 10.

In the face of the growing concerns in Congress and with the public, regarding the condition of the nation's production reactors, as well as the NAS findings, how can DOE demonstrate that continued operation of these reactors will not pose undue risks to public health and safety?

Response

In Chapter 1 of the report, the committee recommended that DOE articulate and define a safety objective for the production reactors and then verify compliance. In Chapter 3, we recommended that an independent external advisory committee be established. The committee believes these are measures that can help instill public confidence in DOE oversight of the production reactors.

Question 11.

NAS cites weaknesses in the confinement systems at Savannah River and N-Reactor. The public relies on this for protection. Would it be necessary to shut plants down to allow upgrade of confinement systems? If a Savannah River plant were shut down for such an upgrade, wouldn't it be vulnerable to an EIS before it could be restarted?

Response

The committee did not examine the requirements for operational readiness or restart of the production reactors.

Question 12.

If any type of accident occurred at N-Reactor or at any of the Savannah River reactors, even if it wasn't a serious accident, don't you feel this would be a very serious threat to future operation of any of these reactors? Worse than that, it is my firm belief that any accident at these reactors will have unavoidable repercussions with respect to future operation of our commercial nuclear industry despite their technical dissimilarities. Does NAS share my concerns?

Response

The committee did not address the public health or policy consequences of accidents at the production reactors.

Question 13.

Is DOE, in your opinion, committed to doing what is necessary to bring the Savannah River reactors up to full-power operating capacity until such time as new production capability is available?

Response

The contractor is undertaking an extensive program to assure the propriety of the restoration of full power at the reactors. We recommended that DOE assure itself on the basis of rigorous external review that it has a thorough understanding of the behavior of the reactors in a loss-of-coolant accident before restoring power.

Question 14.

Has DOE indicated what plans they have made to implement any or all of the changes that may be recommended by the National Academy of Sciences study?

Response

DOE has announced publicly that it intends to respond to all of our recommendations. The details have not yet been announced and presumably could not yet have been developed.

Question 15.

How vulnerable are the Savannah River reactors to temporary or permanent shutdown for environmental and safety concerns?

Response

The committee did not address this question in any quantitative sense. The report examines a number of technical issues for which uncertainties exist.

Question 16.

Did NAS determine if any of the Savannah River reactor support facilities are of such age and condition to raise significant concerns? (fuel fabrication and reprocessing facilities, etc.)

Response

The committee only examined issues directly related to operation of the reactors.

Question 17.

Do you believe that the Savannah River reactors will ever operate at full power? What will it take to make that happen?

Response

The committee did not address these questions. As noted in response to question 14, we recommend that the Department complete certain actions before authorizing the restoration of full power.

Question 18.

Were the Savannah River reactors built to withstand design basis accidents (i.e., off-normal transients short of fuel melting), similar to the design requirements imposed on commercial nuclear power plants?

Response

The reactors were constructed before establishment of the licensing process for commercial reactors. Later on, comparability reviews were conducted and plant modifications were undertaken. To our knowledge, all of the reactor safety systems now have design-basis requirements.

Question 19.

Can DOE say with a high degree of certainty that the Savannah River reactors could withstand design basis accidents without undue risk to the public, even at 50% power? Are there any data to substantiate your view? Is data being developed?

Response

It would take a highly unlikely accident to produce conditions that would challenge the capability of the ECCS to cool the fuel. The committee did not review the computational basis for the current 50% power limits at Sanannah River. DOE and the contractor believe the current reduced power limits would not result in boiling in the fuel assemblies during a loss-of-coolant accident, and, if so, the committee's main concern with the former power limits has been addressed. As explained on pages 27-28 of our report, the contractor has a program underway to examine the power limits.

Question 20.

In your opinion, can a heavy water reactor be built with specific modifications that meet today's safety concerns and still be brought on-line rapidly? Can simple, straight-forward modifications be made to the existing heavy water reactor design that would bring it up to today's standards?

Response

This question goes beyond the scope of the committee's deliberations.

Question 21.

What is the status of NAS's study (requested by DOE) of advanced reactor technology--i.e., the HTGR and LMR alternatives--for materials production reactor use? Who will participate in this study? When will it be completed?

Response

The NAS has established a different committee to examine advanced reactor technology for production. I understand that the committee is only now getting underway. The committee is composed of experts in the relevant areas; it intends to complete its work by November 1988.

Question 22.

To what extent does DOE's announced plan for establishment of an external oversight committee for nuclear safety meet the objectives you laid out in your report?

Response

DOE's announcement is consistent with our recommendation. A full comparison must await the release of further details by DOE.